WADC TECHNICAL REPORT 55-322

FC

EVALUATION OF TESTERS FOR THE DETERIORATION OF DOPED-FABRIC SURFACES ON AIRCRAFT

BRUCE K. BAIN

AND

LAWRENCE P. SLIVKA

GOODYEAR AIRCRAFT CORPORATION

AKRON, OHIO

FEBRUARY 1956

WRIGHT AIR DEVELOPMENT CENTER

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MATERIALS LABORATORY

CONTRACT No. AF 33(600)-27305

PROJECT No. 7312

TASK No. 73121

WRIGHT AIR DEVELOPMENT CENTER

AIR RESEARCH AND DEVELOPMENT COMMAND

UNITED STATES AIR FORCE

WRIGHT-PATTERSON AIR FORCE BASE, OHIO

Carpenter Litho & Prtg. Co., Springfield, O.

200 - April 1956

FOREWORD

This report was prepared by Goodyear Aircraft Corporation under USAF Contract No. AF33(600)-27305. This contract was initiated under Project No. 7312, "Finishes and Materials Preservations", Task No. 73121, "Organic Protective Coatings", formerly RDO No. 611-12, "Organic Protective Coatings and Related Materials", and was administered under the direction of the Materials Laboratory, Directorate of Research, Wright Air Development Center, with Dr. E. E. Jukkola acting as project engineer.

Acknowledgement is made for the cooperation of the NACA Airplane Crash Facility, Ravenna Arsennal, Ohio and Hayes Aircraft Corporation, Birmingham, Alabama, in supplying doped-fabric samples and facilities for field testing of doped-fabric surfaces on aircraft. Acknowledgement is also made to Mr. Thomas E. Hughes for supplying an additional Mobile AMA (Hughes) tester and material for new tips for this tester.

This report covers work conducted from August 1954 to August 1955.

ABSTRACT

Three types of portable doped-fabric testers, the Mobile AMA (Hughes) tester, Seyboth fabric tester, and CAA impact tester, are evaluated as methods of determining deterioration of doped-fabric surfaces on aircraft. Correlation of these testers with the Mullen burst tester is made, and the effects of different temperatures and relative humidities on the tester readings are determined. It is found that the Mobile AMA (Hughes) tester is useful as a survey instrument for determining deterioration of doped-fabric surfaces on aircraft. In their present forms, the CAA and Seyboth testers are found to be useful only for weaker fabrics than those specified by Air Force standards.

PUBLICATION REVIEW

This report has been reviewed and is approved.

FOR THE COMMANDER:

M. R. WHITMORE
Technical Director
Materials Laboratory
Directorate of Research

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				7	7½	8	8½	9	9½	10	10½	11	11½	12
	60	30	Hughes 138				0	3	6	8	8	10		
	60	45						2	4	7	9			
	60	60					2	5	5	8	9			
228	60	75			0	2	4	7	7	8	9			
	60	90			1	3	6	7	10					
	60	30	Hughes 140					2	3	6	9			
	60	45			0	0	6	6	8	10				
	60	60				0	3	6	7	9				
230	60	75			0	2	5	6	10					
	60	90			0	5	5	9	10					

Sample No.	Temp.	Humidity	Tester	Last Exposed Band of Color				
231	60	30	Seyboth #1	yw	yw	gr 1	yw	yw
			" #2	gr 1	yw	yw	gr 1	gr 1
			" #3	yw	yw	yw	gr 1	gr 1
	60	45	Seyboth #1	yw	yw	yw	yw	yw
			" #2	yw	yw	yw	yw	yw
			" #3	yw	yw	yw	yw	yw
	60	60	" #1	yw	yw	yw	yw	yw
			" #2	yw	yw	yw	yw	yw
			" #3	yw	yw	yw	yw	yw
	60	75	Seyboth #1	yw	yw	yw	yw	yw
			" #2	yw	yw	yw	yw	yw
			" #3	yw	yw	yw	yw	yw
	60	90	" #1	yw	yw	yw	yw	yw
			" #2	yw	yw	yw	yw	yw
			" #3	yw	yw	yw	yw	yw

			CAA Tester	Holes in 10 Tries for Each Tester		
				CAA #1	CAA #2	CAA #3
	60	30		No holes 10 crack	No holes 10 cr.	No holes 10 cr.
	60	45		No holes 10 crack	No holes 8 cr.	No holes 10 cr.
245	60	60		No holes 8 cr.	No holes 9 cr.	No holes 10 cr.
	60	75		No holes 10 cr.	No holes 10 cr.	No holes 10 cr.
	60	90		1 9 cr.	No holes 10 cr.	No holes 10 cr.

Table 6 (continued)

Number of Holes in 10 Tries for each Hughes Setting

Sample No.	Temp.	Humidity	Tester	7	7½	8	8½	9	9½	10	10½	11	11½	12
	0	32	Hughes 138							3	5	6	7	
263	0	45							2	3	7	8		
	0	90							4	7	8	9		
	0	32	Hughes 140	1	1	6	9							
241	0	45		2	4	4	7							
	0	90		2	5	4	6	10	10					

Sample No.	Temp.	Humidity		Last Exposed Band of Color				
			Seyboth #1	yw	yw	yw	yw	yw-gr
	0	32	" #2	gr 1	gr 1	gr 1	gr 1	gr 1
			" #3	yw-gr 1	yw-gr 1	yw-gr 1	yw-gr 1	yw-gr 1
			Seyboth #1	yw	yw	yw	yw	yw
226	0	45	" #2	gr 1	gr 1	gr 1	yw-gr 1	yw-gr 1
			" #3	yw	yw	yw-gr 1	yw-gr 1	yw-gr 1
			Seyboth #1	yw	yw	yw	yw	yw
	0	90	" #2	yw	yw	gr 1	gr 1	gr 2
			" #3	gr 1	gr 2	gr 1	gr 2	gr 1

Sample No.	Temp.	Humidity	CAA Tester	Holes in 10 Tries for each Tester					
				CAA #1		CAA #2		CAA #3	
	0	32				0	0 cr.	0	0 cr.
88	0	45				0	0	0	0
	0	90		0	9 cr.	0	0	0	0

Table 6 (continued)

Sample No.	Temp.	Humidity	Tester	Number of Holes in 10 Tries for Each Hughes Setting										
				7	7½	8	8½	9	9½	10	10½	11	11½	12
	30	30	Hughes 138				3	6	7	10				
149	30	43					3	7	8					
	30	90				1	3	5	10			10		
	30	30	Hughes 140				3	6	10					
61	30	43					0	2	6	10				
	30	90					2	5	4	6	10			

Sample No.	Temp.	Humidity	Tester	Last Exposed Band of Color				
	30	30	Seyboth #1	gr 1	yw	yw	yw-gr 1	yw-gr 1
			" #2	gr 1	yw-gr 1	yw-gr 1	gr 1	gr 1
			" #3	gr 1	gr 1	gr 1	gr 1	gr 1
	30	43	Seyboth #1	yw-gr 1	yw-gr 1	yw-gr 1	yw-gr 1	yw-gr 1
214			" #2	gr 1	gr 1	gr 1	gr 1	gr 1
			" #3	gr 1	gr 1	gr 1	gr 1	gr 1
	30	90	Seyboth #1	yw	gr 1	yw	gr 1	gr 1
			" #2	yw	gr 1	gr 1	gr 1	gr 1
			" #3	yw	gr 1	gr 1	gr 1	yw

Sample No.	Temp.	Humidity	CAA Tester	Holes in 10 Tries for each Tester					
				CAA #1		CAA #2		CAA #3	
	30	30				0	1 cr.	0	0 cr.
	30	43				0	0 cr.	0	0 cr.
84	30	90		0	0 cr.	0	0 cr.	0	0 cr.

Table 6 (continued)

Sample No.	Temp.	Humidity	Tester	Number of Holes in 10 Tries for Each Hughes Setting										
				7	7½	8	8½	9	9½	10	10½	11	11½	12
	90	30	Hughes 138						0	3	6	7	10	
	90	45	"						0	3	6	8	10	
128	90	60	"						0	4	5	9		
	90	75	"					1	0	2	4	7		
	90	90	"	0		0	0	3	4	9				
	90	30	Hughes 140			3	5	5	8					
	90	45	"			0	4	5	8					
118	90	60	"				4	4	9					
	90	75	"			0	4	7	10					
	90	90	"				4	5	9	10				

Sample No.	Temp.	Humidity	Tester	Last Exposed Band of Color				
	90	30	Seyboth #1	yw	yw	yw	yw	yw
			" #2	yw	yw	yw	yw	yw
			" #3	yw	yw	yw	yw	yw
	90	45	Seyboth #1	yw	yw	yw	yw	yw
			" #2	yw	yw	yw	yw	yw
81			" #3	yw	yw	yw	yw	yw
	90	60	Seyboth #1	yw	yw	yw	yw	yw
			" #2	yw	yw	yw	yw	yw
			" #3	yw	yw	yw	yw	yw
	90	75	Seyboth #1	yw	yw	yw	yw	yw
			" #2	yw	yw	yw	yw	yw
			" #3	yw	yw	yw	yw	yw
	90	90	Seyboth #1	yw	yw	yw	yw	yw
			" #2	yw	yw	yw	yw	yw
			" #3	yw	yw	yw	yw	yw

Sample No.	Temp.	Humidity	CAA Tester	Holes in 10 Tries for each Tester					
				CAA #1		CAA #2		CAA #3	
	90	30		0	9 cr.	0	5 cr.	0	7 cr.
	90	45		0	8	0	8	0	9
246	90	60		0	8	0	8	0	9
	90	75		0	5	0	9	0	8
	90	90		0	2	0	9	0	7

Table 6 (continued)

Number of Holes in 10 Tries for Each Hughes Setting

Sample No.	Temp.	Humidity	Tester	7	7½	8	8½	9	9½	10	10½	11	11½	12
	120	30	Hughes 138					0	1	6	5	9		
	120	45						2		1	7	7		
39	120	60								0	6	8		
	120	75								2	4	6		
	120	90					4	7			8	10		
	120	30	Hughes 140	8		10		10						
	120	45		8	10									
163	120	60		9	10									
	120	75		8	10									
	120	90		8	10									

Sample No.	Temp.	Humidity	Tester	Last Exposed Band of Color				
			Seyboth #1	YW-GR1	YW-GR1	YW-GR1	YW-GR1	YW-GR1
	120	30	" #2	YW-GR1	YW-GR1	YW-GR1	YW-GR1	YW-GR1
			" #3	YW-GR1	YW-GR1	YW-GR1	YW-GR1	YW-GR1
			Seyboth #1	YW-GR1	YW-GR1	YW-GR1	YW-GR1	YW
139	120	45	" #2	YW-GR1	YW-GR1	YW-GR1	YW-GR1	YW-GR1
			" #3	YW-GR1	GR1	GR1	GR1	GR1
			Seyboth #1	YW	YW	YW	YW	YW
	120	60	" #2	YW-GR1	YW-GR1	YW-GR1	YW-GR1	YW-GR1
			" #3	YW	YW	YW	YW	YW
			Seyboth #1	YW	YW	YW	YW	YW
	120	75	" #2	YW-GR1	YW-GR1	YW-GR1	YW-GR1	YW-GR1
			" #3	YW	YW	YW	YW	YW
			Seyboth #1	YW-GR1	YW-GR1	YW-GR1	YW-GR1	YW-GR1
	120	90	" #2	YW-GR1	YW-GR1	YW-GR1	YW-GR1	YW-GR1
			" #3	YW-GR1	YW-GR1	YW-GR1	YW-GR1	YW-GR1

Sample No.	Temp.	Humidity	CAA Tester	Holes in 10 Tries for each Tester		
				CAA #1	CAA #2	CAA #3
	120	30		0 1 Cr.	0 6 Cr.	0 10 Cr.
	120	45		0 0 Cr.	0 0 Cr.	0 10 Cr.
254	120	60		0 2 Cr.	0 3 Cr.	0 10 Cr.
	120	75		0 2 Cr.	0 3 Cr.	0 10 Cr.
	120	90		Jammed	0 3 Cr.	0 10 Cr.

Table 6 (continued)

Number of Holes in 10 Tries for each Hughes Setting

Sample No.	Temp.	Humidity	Tester	7	7½	8	8½	9	9½	10	10½	11	11½	12
	0	30	Hughes 138						0	3	5	6	8	
	30	30								1	3	7	10	
101	60	30								0	1	5	6	8
	90	30						0		2	3	7	7	
	120	30							0	4	5	8		
	0	30	Hughes 140				1	2	6	8				
	30	30					2	5	7					
119	60	30					0	2	7	9				
	90	30				0	4	7	8					
	120	30			4	5	8	10						

Sample No.	Temp.	Humidity		Last Exposed Band of Color				
			Seyboth #1	GR1	GR1	YW-GR1	YW-GR1	YW-GR1
	0	30	" #2	GR1	GR1	GR1	GR1	GR1
			" #3	GR1	GR1	GR1	GR1	GR1
			Seyboth #1	GR1	GR1	GR1	GR1	YW-GR1
	30	30	" #2	YW-GR1	GR1	GR1	GR1	GR1
			" #3	GR1	GR1	GR1	GR1	GR1-GR2
			Seyboth #1	YW-GR1	GR1	YW-GR1	GR1	GR1
201	60	30	" #2	GR1	GR1	GR1	GR1	GR1
			" #3	YW-GR1	GR1	YW-GR1	GR1	GR1
			Seyboth #1	GR1	YW-GR1	YW-GR1	GR1	GR1
	90	30	" #2	GR1	GR1	GR1	YW-GR1	YW-GR1
			" #3	YW-GR1	GR1	GR1	GR1	GR1
			Seyboth #1	YW-GR1	YW-GR1	YW-GR1	YW-GR1	YW-GR1
	120	30	" #2	YW	YW	YW	GR1	GR1
			" #3	GR1	GR2	GR2	GR1	GR1

Sample No.	Temp.	Humidity		Holes in 10 Tries for each Tester					
			CAA Tester	CAA #1		CAA #2		CAA #3	
	0	30				0	10 Cr.	0	10 Cr.
	30	30				1	9	0	10
202	60	30		0	10 Cr.	0	10	0	10
	90	30		0	10	0	10	0	10
	120	30		0	3	0	2	0	10

Table 6 (continued)

Sample No.	Temp.	Humidity	Tester	Number of Holes in 10 Tries for each Hughes Setting										
				7	7½	8	8½	9	9½	10	10½	11	11½	12
	0	45	Hughes 138					0	4	5	8			
	30	45							1	3	6	10		
77	60	45							0	5	7	8	10	
	90	45							1	3	4	7	9	
	120	45								2	5	9		
	0	45	Hughes 140						0	3	8	9		
	30	45							2	4	6	9		
100	60	45				0	1	4	6	8	10			
	90	45				0	1	2	6	8	10			
	120	45					3	6	10					

Sample No.	Temp.	Humidity		Last Exposed Band of Color				
	0	45	Seyboth #1	GR1	GR1	YW-GR1	YW-GR1	YW-GR1
			" #2	GR1	GR1	YW-GR1	GR1-GR2	GR1-GR2
			" #3	GR1	GR1	GR1	GR1	GR1
	30	45	Seyboth #1	YW	YW	YW-GR1	YW-GR1	YW-GR1
			" #2	YW-GR1	YW-GR1	YW-GR1	YW-GR1	YW-GR1
			" #3	YW	YW	YW	YW	YW
219	60	45	Seyboth #1	YW	YW	YW	YW	YW
			" #2	YW	YW	YW	YW	YW
			" #3	YW	YW	YW	YW	YW
	90	45	Seyboth #1	YW	YW	YW	YW	YW
			" #2	YW	YW	YW	YW	YW
			" #3	YW	YW	YW	YW	YW
	120	45	Seyboth #1	YW	YW-GR1	YW	YW-GR1	YW
			" #2	YW-GR1	YW-GR1	YW-GR1	YW-GR1	YW-GR1
			" #3	YW-GR1	YW-GR1	YW-GR1	YW-GR1	YW-GR1

Sample No.	Temp.	Humidity	CAA Tester	Holes in 10 Tries for each Tester		
				CAA #1	CAA #2	CAA #3
	0	45			0 6 Cr.	0 10 Cr.
	30	45			0 10	0 10
275	60	45		0 6 Cr.	0 8	0 3
	90	45		0 7	0 6	0 6
	120	45		0 0	0 10	0 10

Table 6 (continued)

Number of Holes in 10 Tries for each Hughes Setting

Sample No.	Temp.	Humidity	Tester	7	7½	8	8½	9	9½	10	10½	11	11½	12
	60	60	Hughes 138				1	0	5	7	7	7	10	
220	90	60			0	3	5	2	9	10				
	120	60				3	5	8						
	60	60	Hughes 140		1	4	6	9	9	9	10			
224	90	60			1	5	2	5	9					
	120	60			2	8	9							

Sample No.	Temp.	Humidity		Last Exposed Band of Color				
			Seyboth #1	OR	YW	YW	YW	YW
	60	60	" #2	YW	YW	YW	YW	YW
			" #3	YW	YW	YW	YW	YW
			Seyboth #1	YW	OR	YW	YW	YW
287	90	60	" #2	YW	YW	YW	OR	OR
			" #3	OR	YW	YW	YW	OR
			Seyboth #1	YW	YW	YW	YW	YW
	120	60	" #2	YW	YW	OR	OR	OR
			" #3	YW	YW	YW	YW	YW

Sample No.	Temp.	Humidity	CAA Tester	Holes in 10 Tries for each Tester					
				CAA #1		CAA #2		CAA #3	
	60	60		0	10 Cr.	0	10 Cr.	0	10 Cr.
290	90	60		0	10	0	10	0	10
	120	60		0		0	3	0	7

Table 6 (continued)

Sample No.	Temp.	Humidity	Tester	Number of Holes in 10 Tries for each Hughes Setting										
				7	7½	8	8½	9	9½	10	10½	11	11½	12
186	60	75	Hughes 138	6	4	7	8	10						
	90	75		9	9	10								
	120	75		9										
146	60	75	Hughes 140						0	2	2	4	7	
	90	75								0	3	2	8	
	120	75								1	4	9		

Sample No.	Temp.	Humidity		Last Exposed Band of Color				
60	60	75	Seyboth #1	YW	YW	YW	YW	YW
			" #2	YW	YW	YW	YW	YW
			" #3	YW	GR1	GR1	GR1	GR1
	90	75	Seyboth #1	YW	YW	YW	YW	YW
			" #2	YW	GR1	YW	YW	YW
			" #3	YW	YW	GR1	GR1	YW
	120	75	Seyboth #1	GR1	GR1	GR1	GR1	GR1
			" #2	YW	GR2	GR2	GR1	GR1
			" #3	GR1	GR1	GR1	GR1	GR2

Sample No.	Temp.	Humidity	CAA Tester	Holes in 10 Tries for Each Tester					
				CAA #1		CAA #2		CAA #3	
168	60	75		1	3 Cr.	0	0 Cr.	0	0 Cr.
	90	75		0	0	1	2	0	1
	120	75		0	0	0	0	0	0

Table 6 (continued)

Sample No.	Temp.	Humidity	Tester	Number of Holes in 10 Tries for each Hughes Setting										
				7	7½	8	8½	9	9½	10	10½	11	11½	12
148	0	90	Hughes 138					3	4	7	10			
	30	90					0	1	3	6	7	8		
	60	90		0	4	2	8							
	90	90				3	8	9						
	120	90			4	7	9							
161	0	90	Hughes 140			1	1	5	10					
	30	90						1	6	6	7	8		
	60	90			1	6	6	7	9					
	90	90			4	6	9	9						
	120	90		9		10								

Sample No.	Temp.	Humidity	Tester	Last Exposed Band of Color				
18	0	90	Seyboth #1	GR1	GR1	GR1	GR1	GR1
			" #2	GR2	GR2	GR2	GR2	GR1
			" #3	GR2	GR2	GR2	GR2	GR2
	30	90	Seyboth #1	GR1	GR1	GR1	GR1	YW
			" #2	GR1	GR1	GR1	GR1	GR1
			" #3	GR1	GR1	GR1	GR1	GR1
	60	90	Seyboth #1	GR1	YW	YW	YW	YW
			" #2	GR1	GR1	GR1	GR1	GR1
			" #3	GR1	GR1	GR1	GR1	GR1
	90	90	Seyboth #1	YW	YW	YW	YW	YW
			" #2	YW	YW	YW	YW	GR1
			" #3	YW	YW	YW	GR1	GR1
	120	90	Seyboth #1	GR1	GR1	GR1	GR1	GR1
			" #2	GR1	GR1	GR2	GR2	GR2
			" #3	GR2	GR2	GR2	GR2	GR2

Sample No.	Temp.	Humidity	CAA Tester	Holes in 10 Tries for each Tester					
				CAA #1		CAA #2		CAA 33	
20	0	90		0	2 Cr.	0	2 Cr.	0	1 Cr.
	30	90		0	0	0	0	0	0
	60	90		0	0	0	2	0	0
	90	90		0	0	0	0	0	0
	120	90		Jammed		0	0	0	0

Table 6 (continued)

Sample No.	Temp. °F	R.H. %	Tester	Number of Holes in 10 Tries for Each Hughes Setting 7	7½	8	8½	9	9½	10	10½	11	11½	12
478	60	30	133						5	9				
344			133			2	7		10					
6			133					2	4	7				
2			138								0	4	9	
4			138								2	6	9	
3			140						3	5	8			
5			140						3	3	8			
478	60	40	133							3	7			
344			133			1	6							
6			133					2	5	10				
2			138								4	5	8	
4			138							0	5	9		
3			140						1	5	9			
5			140						0	3	5	8		
478	60	60	133						2	4	6			
344			133				3	8						
6			133						2	2	5			
2			138									2	6	
4			138									3	8	
3			140						2	6	7			
5			140								4	6		
478	60	90	133								4	4	5	
344			133							3	8			
6			133								1	3	2	5
2			138									0	1	2
4			138										3	5
3			140									2	7	
5			140										4	5

Table 6 (continued)

Sample No.	Temp. °F	R.H. %	Tester	Number of Holes in 10 Tries for Each Hughes Setting 7	7½	8	8½	9	9½	10	10½	11	11½	12
478	90	30	133					4	6	9				
344			133			3	5							
6			133					4	7					
2			138							3	4	8		
4			138							2	7			
3			140					4	6	8				
5			140						2	5				
478	90	60	133								3	7		
344			133						3	9	10			
6			133								4	8		
2			138									1	6	
4			138									4	9	
3			140							4	7	7		
5			140								4	7		
8	90	90	133								2	3	3	6
344			133							3	7	8		
6			133										1	6
2			138									1		2
4			138											5
3			140										4	7
5			140										3	5

TABLE 7

Hughes Tester & Mullen Tester Readings for the same Doped-Fabric Samples

Sample No.	Mullen Test Strength Avg. psi	Hughes Tester Readings		
		#133	#138	#140
189	59	–	–	–
294	64	–	–	–
194	67	–	–	–
195	70	–	–	–
276	77	–	–	–
285	80	–	–	–
279	80	–	–	–
280	84	–	–	–
273	85	–	–	–
288	88	–	–	–
203	90	–	–	–
284	90	–	–	–
212	92	–	–	–
291	97	–	–	–
207	101	–	–	–
171	109	6.6	6.6	6.9
222	114	–	6.6	6.6
192	115	6.5	6.6	6.6
223	118	6.9	6.7	6.5
296	121	6.7	7.1	6.6
174	121	6.5	7.0	6.9
206	129	7.15	7.35	7.35
197	130	6.7	6.9	6.7
269	133	6.7	6.9	7.0
191	133	6.5	6.9	7.0
184	134	6.6	7.25	7.15
209	135	–	7.0	6.5
185	142	6.9	6.9	6.7
175	144	6.8	7.3	7.3
218	147	7.3	7.75	7.5
111	148	6.6	6.7	6.7
179	152	8.7	9.0	9.0
265	152	7.3	7.8	7.5
267	153	8.3	8.75	8.75
256	158	9.0	9.5	8.75
112	160	6.8	7.25	7.0
182	162	8.5	9.65	8.65
232	165	7.5	7.65	6.5
234	165	8.0	7.35	7.6

TABLE 7 (CONTINUED)

Sample No.	Mullen Test Strength Avg. psi	Hughes Tester Readings #133	#138	#140
252	166	8.15	8.8	8.25
242	166	7.65	8.35	7.75
257	167	8.25	9.15	8.5
262	167	8.4	9.5	8.5
260	169	8.25	9.3	8.4
216	174	8.25	8.65	7.5
247	175	9.0	10.15	9.5
243	177	8.6	8.65	8.4
167	179	10.25	10.25	9.3
384	180	8.3	9.0	8.5
25	181	8.3	8.5	7.9
22	181	10.1	10.3	9.65
381	181	8.65	9.75	8.75
137	183	7.0	7.75	7.0
204	183	8.8	9.9	9.8
380	183	8.25	9.25	8.75
381	183	8.65	9.2	8.75
383	189	8.15	8.7	8.25
354	190	8.95	9.5	9.25
26	192	8.6	10.2	9.65
382	193	8.1	9.1	8.5
384	194	9.0	9.65	9.2
382	197	8.6	9.5	8.65
366	197	9.0	9.65	9.2
275	200	10.9	11.4	11.1
468	201	10.35	11.0	10.75
374	201	8.85	9.6	9.0
356	202	9.0	9.8	9.4
404	202	9.4	10.75	10.4
274	202	10.65	11.8	10.65
71	203	9.05	10.55	9.25
469	205	10.0	11.3	11.0
366	205	9.3	9.5	9.25
399	206	10.0	11.0	10.75
402	208	10.35	11.1	10.6
470	210	10.5	11.4	10.3
458	210	10.55	11.25	10.8
463	210	10.0	11.3	10.65
471	211	9.7	10.8	10.5

TABLE 7 (CONTINUED)

Sample No.	Mullen Test Strength Avg. psi	Hughes Tester Readings #133	#138	#140
470	211	10.25	11.0	10.4
68	215	9.05	11.0	9.0
456	216	10.55	11.35	11.0
463	218	10.5	11.8	10.8
451	220	10.75	11.3	10.75
450	221	10.8	11.5	11.0
76	223	9.15	10.75	9.6
249	223	10.5	11.6	11.0
477	227	9.5	11.0	10.65
288	228	10.2	10.65	10.4
472	229	10.0	10.75	10.5
477	231	10.75	10.9	11.05
454	235	10.75	10.8	10.6
85	235	8.8	8.8	8.75
64	237	10.0	10.85	9.9
103	241	9.6	9.6	9.6
236	241	10.25	10.8	10.4
150	243	10.0	11.25	10.1
1	243	9.65	10.4	9.8
9	244	9.75	10.75	9.75
444	244	9.7	11.15	10.1
59	244	9.5	10.7	10.25
442	246	10.0	11.0	10.1
65	249	9.25	10.1	9.5
162	255	10.55	11.3	11.0
159	255	9.5	10.6	10.15
109	259	9.6	10.0	9.5
160	261	10.2	11.65	10.2
51	264	9.65	10.5	9.75
49	264	9.25	10.2	10.0
134	265	10.5	11.25	10.75
152	267	10.25	11.0	10.5
441	267	10.25	11.25	10.0
45	274	9.35	10.25	9.7
42	275	9.5	10.65	9.6
50	281	9.5	10.75	9.25
359	287	11.5	12.4	11.4
40	295	9.75	10.4	9.75

TABLE 8

Seyboth Tester & Mullen Tester Readings for the Same Doped-Fabric Samples

Sample No.	Mullen Test Strength Avg. psi	Average Seyboth Reading Tester #1	Tester #2	Tester #3
189	59	Orange-Red	Orange	Orange-Red
294	64	-	-	-
194	67	-	-	-
195	70	-	-	-
276	77	Orange	Orange	Orange
285	80	Orange	Orange-Red (+)	Orange-Red
279	80	Orange	Orange - YW	Orange
280	84	Orange - YW(-)	Orange - YW	Orange - YW
273	85	-	-	-
288	88	Orange - YW(+)	YW (-)	YW
203	90	-	-	-
284	90	Orange - YW	Orange - YW(-)	Orange - YW (+)
212	92	Orange - YW	Orange - YW	YW (-)
291	97	Orange --YW	YW (-)	YW (-)
207	101	Orange - YW	Orange - YW	Orange - YW
171	109	Red	Red	Red
222	114	YW	YW (+)	YW
192	115	YW (-)	YW (-)	YW (-)
223	118	YW	YW	YW (-)
296	121	YW	YW	YW
174	121	Orange - YW	Orange - YW	Orange - YW
206	129	YW	YW	YW
197	130	YW	YW	YW
269	133	YW	YW - GR(-)	YW (+)
191	133	YW	YW	YW (-)
184	134	YW	YW	YW
209	135	YW	YW	YW
185	142	YW	YW	YW
175	144	YW	YW (+)	YW (+)
218	147	Orange - YW	YW	YW (+)
111	148	YW	YW (-)	YW
179	152	YW (+)	YW (+)	YW (+)
265	152	YW - GR	GR1	GR1 (-)
267	153	GR1-2	GR1 (+)	GR1
256	158	GR1 (-)	GR1 (+)	GR1 (+)
112	160	YW	YW	YW
182	162	YW - GR	YW - GR(-)	GR1 (+)
232	165	YW	YW	YW
234	165	YW	YW	YW

TABLE 8 (CONTINUED)

Sample No.	Mullen Test Strength Avg. psi	Average Seyboth Reading Tester #1	Tester #2	Tester #3
252	166	YW - GR (+)	YW - GR (+)	GR1
242	166	YW	YW - GR	YW
257	167	GR1	GR1 (+)	YW - GR (+)
262	167	GR1-2	GR1-2	GR1-2
260	169	YW - GR	GR1 (-)	GR1 (-)
216	174	YW	YW	YW
247	175	GR1	GR1	GR1
243	177	YW	YW - GR	YW (+)
167	179	GR1 (+)	GR1	GR1-2 (-)
384	180	YW - GR (+)	GR1	GR1
25	181	YW - GR (+)	GR1	GR1
22	181	GR1	GR1	GR1-2 (-)
381	181	GR1 (-)	GR1	GR1
137	183	YW	YW	YW
204	183	GR1	GR1	GR1-2
380	183	GR1 (-)	GR1	GR1
381	183	YW - GR (-)	GR1 (-)	GR1
383	189	GR1 (-)	GR1 (-)	YW - GR (-)
354	190	GR1	GR1 (+)	GR1-2 (-)
26	192	GR1-2	GR1-2 (-)	GR1-2 (-)
382	193	YW - GR (-)	GR1	GR1
384	194	GR1	GR1-2 (-)	GR1-2 (-)
382	197	YW (+)	GR1 (-)	YW (+)
366	197	GR1	GR1 (+)	GR1-2
275	200	GR1-2	GR1-2	GR1-2
468	201	GR1 (+)	GR1	GR1-2
374	201	YW (+)	GR1	GR1 (-)
356	202	GR1-2	GR2 (-)	GR2
404	202	GR1-2	GR1-2 (+)	GR1-2 (+)
274	202	GR1 (-)	GR1-2	GR1
71	203	GR1	GR1-2	GR2
469	205	GR1-2 (-)	GR1-2	GR1-2
366	205	YW (+)	GR1 (-)	GR1
399	206	GR1 (-)	GR1 (+)	GR1-2 (-)
402	208	GR1 (-)	GR1	GR1
470	210	YW - GR (+)	GR1	GR1
458	210	GR1 (-)	GR1 (-)	GR1 (+)
463	210	GR1 (+)	GR1-2 (-)	GR1-2
471	211	YW - GR	GR1	GR1
470	211	GR1	GR1	GR1
68	215	GR1 (-)	GR1	GR1
456	216	GR1-2 (-)	GR1-2	GR2 (-)
463	218	GR1	GR1	GR1 (+)
451	220	GR1	GR1 (+)	GR1 (+)

TABLE 8 (CONTINUED)

Sample No.	Mullen Test Strength Avg. psi	Average Seyboth Reading Tester #1	Tester #2	Tester #3
450	221	GR1	GR1-2	GR1-2 (-)
76	223	GR1-2	GR2 (-)	GR1-2
249	223	GR2	GR2	GR2
477	227	YW - GR	GR1 (-)	GR1 (-)
288	228	GR1	GR1-2 (-)	GR1-2 (+)
472	229	GR1 (-)	GR1	GR1
477	231	GR1-2	GR1-2	GR1-2
454	235	GR1 (+)	GR2 (-)	GR1-2
85	235	GR1 (-)	GR1	GR1
64	237	GR1-2 (-)	GR2	GR2 (-)
103	241	GR1 (+)	GR1-2	GR1-2 (-)
236	241	GR2 (-)	GR2	GR2
150	243	GR1-2	GR2	GR2
1	243	GR1	GR1	GR1-2
9	244	GR1	GR1	GR1-2
444	244	GR2	GR2	GR2
59	244	GR2 (-)	GR2 (-)	GR2 (-)
442	246	GR1-2 (+)	GR2	GR2
65	249	GR1-2	GR2	GR2
162	255	GR1-2	GR1 (+)	GR1-2
159	255	GR2 (-)	GR2	GR2
109	259	GR1-2 (-)	GR2 (-)	GR2 (-)
160	261	YW - GR (+)	GR1-2	GR1-2
51	264	GR2 (-)	GR2	GR2
49	264	GR2 (-)	GR2	GR2 (-)
134	265	GR2 (-)	GR2	GR2
152	267	GR1	GR1-2	GR1-2
441	267	GR2 (-)	GR2 (-)	GR2 (-)
45	274	GR2 (-)	GR2 (-)	GR2
42	275	GR1-2	GR2	GR2 (-)
50	281	GR2	GR2	GR2
359	287	GR2 (+)	GR2 (+)	GR2 (+)
40	295	GR2 (-)	GR2	GR2 (-)

TABLE 9

CAA Tester & Mullen Tester Readings for the Same Doped-Fabric Samples

Sample No.	Mullen Test Strength Avg. psi	Number of Punctures in Ten Trials CAA Tester 1751	CAA Tester 2036
189	59	7	5
294	64	10	8
194	67	10	10
195	70	10	10
276	77	5	8
285	80	8	8
279	80	9	6
280	84	9	6
273	85	6	4
288	88	8	3
203	90	8	7
284	90	4	2
212	92	10	5
291	97	7	3
207	101	5	6
171	109	5	5
222	114	0	0
192	115	5	0
223	118	0	0
296	121	0	0
174	121	4	3
206	129	0	0
197	130	4	2
269	133	0	0
191	133	2	1
184	134	0	0
209	135	0	0
185	142	0	0
175	144	0	1
218	147	0	0
111	148	1	0
179	152	0	0
265	152	0	0
267	153	0	0
256	158	0	0
112	160	2	0
182	162	1	0
232	165	0	0
234	165	0	0
252	166	0	0
242	166	0	0
257	167	0	0

TABLE 9 (CONTINUED)

Sample No.	Mullen Test Strength Avg. psi	Number of Punctures in Ten Trials CAA Tester 1751	CAA Tester 2036
262	167	0	0
260	169	0	0
216	174	0	0
247	175	0	0
243	177	0	0
167	179	0	0
384	180	0	0
25	181	0	0
22	181	0	0
381	181	0	1
137	183	0	0
204	183	0	0
380	183	0	0
381	183	0	1
383	189	1	0
354	190	0	0
26	192	0	0
382	193	0	1
384	194	0	0
382	197	0	0
366	197	0	0
275	200	0	0
468	201	0	0
374	201	1	0
356	202	0	0
404	202	0	0
274	202	0	0
71	203	0	0
469	205	0	0
366	205	0	0
399	206	0	0
402	208	0	0
470	210	0	0
458	210	0	0
463	210	0	0
471	211	0	0
470	211	0	0
68	215	0	0
456	216	0	0
463	218	0	0
451	220	0	0
450	221	0	0
76	223	0	0
249	223	0	0
477	227	0	0
288	228	0	0
472	229	0	0
477	231	0	0

TABLE 9 (CONTINUED)

Sample No.	Mullen Test Strength Avg. psi	Number of Punctures in Ten Trials	
		CAA Tester 1751	CAA Tester 2036
454	235	0	0
85	235	0	0
64	237	0	0
103	241	0	0
236	241	0	0
150	243	0	0
1	243	0	0
9	244	0	0
444	244	0	0
59	244	0	0
442	246	0	0
65	249	0	0
162	255	0	0
159	255	0	0
109	259	0	0
160	261	0	0
51	264	0	0
49	264	0	0
134	265	0	0
152	267	0	0
441	267	0	0
45	274	0	0
42	275	0	0
50	281	0	0
359	287	0	0
40	295	0	0

TABLE 10

Mullen Burst Test Strengths and Pooled Variance of Random Samples Used in Correlation Tests

A. Mullen Burst Tests

Sample No.	Individual Mullen Burst Tests psi					Mean Value psi
348	191	185	194	195	204	194
471	217	217	208	208	208	211
150	230	243	239	260	286	252
68	217	225	215	192	226	215
252	170	164	164			166
456	224	219	208	215	214	216
458	214	199	214	202	220	210
247	185	166	174	188	164	175
179	160	160	115	175	152	152
167	193	194	161	175	172	179
383	179	206	176	195	189	189
382	182	179	206	196	201	193
447	231	217	226	242	242	231
288	203	223	232	234	246	228
152	247	255	252	296	276	267
109	241	247	247	274	285	259
273	92	86	57	87	102	85
280	95	64	73	96	90	84
284	75	104				90
294	62	72	82	57	45	64

TABLE 10 (CONTINUED)

B. Deviation from the Mean

Sample No.	Δ_1	Δ_1^2	Δ_2	Δ_2^2	Δ_3	Δ_3^2	Δ_4	Δ_4^2	Δ_5	Δ_5^2	$\sum_{i=1}^{n} \Delta_i^2$
348	3	9	9	27	0	0	1	1	10	100	137
471	6	36	6	36	3	9	3	9	3	9	99
150	22	484	9	81	13	169	8	64	34	1156	1954
68	2	4	10	100	0	0	23	529	11	121	754
252	4	16	2	4	2	4					24
456	8	64	3	9	8	64	1	1	1	1	139
458	4	16	11	121	4	16	8	64	10	100	317
247	10	100	9	81	1	1	13	169	11	121	472
179	8	64	8	64	37	1369	23	529	0	0	2026
167	14	196	15	225	18	324	4	16	7	49	810
383	10	100	17	289	13	169	6	36	0	0	594
382	11	121	14	196	13	169	3	9	8	64	559
447	0	0	14	196	5	25	11	121	11	121	463
288	25	625	5	25	4	16	6	36	16	256	958
152	20	400	12	144	15	225	29	841	9	81	1691
109	18	324	12	144	12	144	15	225	26	676	1513
273	7	49	1	1	28	784	2	4	17	289	1127
280	11	121	20	400	11	121	12	144	6	36	822
284	15	225	14	196							421
294	2	4	8	64	18	324	7	49	19	361	802

TABLE 10 (CONTINUED)

C. Pooled Variance and Estimate of the Standard Deviation

$$\text{Pooled variance } (S_p^2) = \frac{\sum_{i=1}^{k} \Delta i^2}{\text{total number of tests} - \text{number of samples}}$$

$$= \frac{15682}{95-20}$$

$$= 209.1$$

Standard deviation $(S_p) \approx 14.43$

90% confidence limits for S_p are: (Page 92, Reference 3).

$$\frac{S_p^2}{X_{.95}^2/\text{d.F.}\ (\sum n_i - k)} < S_p^2 < \frac{S_p^2}{X_{.05}^2/\text{d.F.}\ (\sum n_i - k)}$$

$$\frac{209.1}{1.3} < S_p^2 < \frac{209.1}{.739}$$

$$= 160.8 < S_p^2 < 282.5$$

$$12.7 < S_p < 16.8$$

TABLE 11

Probabilities of Rejecting Bad and Good Fabric with Hughes Testers at Settings of 9 and 9½ Lbs.

A. Setting of 9 Lbs. (at 70° F, 65% R.H.; 10 Trials)

Mullen Strength of Sample psi	Percent of Samples Rejected as Weakened		
	133	138	140
150	99	93	96
160	96	82	90
170	88	62	79
180	74	39	62
190	54	20	43
200	32	7	25
210	15	2	12
220	6	.5	5
230	1.6	.07	1.6
240	.4	.01	.5

B. Setting of 9½ Lbs.

150	99.8	98.4	99.1
160	99.2	94	97
170	97	83	92
180	91	65	82
190	78	43	67
200	58	22	48
210	36	9	29
220	19	2.5	15
230	7	.6	6
240	2	.1	2

Table 12

Comparison of Probabilities of Rejecting Bad and Good Fabric with Hughes Tester 138 for 1, 5 and 10 Trials

($9\frac{1}{2}$ Lbs Setting)

Mullen Strength of Sample psi	Percent of Samples Rejected as Weakened		
	1 Trial	5 Trials	10 Trials
150	75	93	98.4
160	68	86	94
170	62	75	83
180	55	60	65
190	47	45	43
200	40	30	22
210	34	17	9
220	27	9	2.5
230	21	4	.6
240	17	1.6	.1

TABLE 13

Hughes Tester Readings for Successive Tests on the Same Doped-Fabric Samples

Tests conducted at 70° F, 65% R.H. with new tip in Hughes Tester 140.
See Figure 3 for view of tip before and after use.
Samples tested in the same order five times.

Sample No.	Hughes Tester Setting for 50% Punctures for Consecutive Test in Lbs.					Change in Tester Setting for 50% Punctures for Consecutive Test in Lbs.			
	1	2	3	4	5	2	3	4	5
479	10.1	10.25	10.0	10.0	10.15	+.15	-.10	-.10	+.05
479	10.5	10.75	10.5	10.5	10.75	+.25	0	0	+.25
478	10.2	10.0	10.15	10.6	10.5	-.20	-.05	+.40	+.30
480	9.75	10.0	9.5	9.65	10.15	+.25	-.25	-.10	+.40
477	10.0	10.4	9.65	10.5	10.75	+.40	-.35	+.50	+.75
481	10.0	9.8	9.5	9.5	10.3	-.20	-.50	-.50	+.30
482	10.35	10.0	10.15	10.5	10.8	-.35	-.20	+.15	+.45
475	10.6	10.3	10.25	10.25	10.25	-.30	-.35	-.35	-.35
482	10.4	9.9	10.5	10.15	10.25	-.50	+.10	-.25	-.15
483	9.5	9.5	9.5	10.0	9.9	0	0	+.50	+.40
469	10.25	9.85	9.8	10.1	10.1	-.40	-.45	-.15	-.15
465	10.9	11.0	11.1	11.1*	11.0	+.10	+.20	+.20*	+.10
459	10.7	10.35	10.75	11.25	11.0	-.35	+.05	+.55	+.30
457	9.5	9.9	10.25	10.5	10.8	-.60	-.25	0	+.30
439	9.5	8.9	8.75	9.5	9.25	-.60	-.75	0	-.25
449	10.15	10.5	10.8	11.0	11.0	+.35	+.70	+.85	+.85
437	9.25	8.9	9.1	9.3	9.0	-.35	-.15	+.05	-.25
483	9.1	9.15	9.25	9.3	9.35	+.05	+.15	+.20	+.25
453	10.75	11.0	11.0	10.75	11.0	+.25	+.25	0	+.25
450	10.85	10.25	10.7	10.8	10.6	-.60	-.15	-.05	-.25
Average change per sample, lbs						-.12	- .11	+ .09	+ .18

* The tester became loose and had to be recalibrated. Since the tester can be calibrated to only the nearest 1/6 lb. the change in average readings after calibration is considered to be a calibration error only.

TABLE 14

Hughes Tester Readings for Doped-Fabric Samples of the Same Mullen Value But Different Weights

Tests conducted at 70° F, 65% R.H. (Selected data from Tables 2 and 7),

Sample No.		Mullen Test Strength Avg. psi	Wt. of Dope Oz/Yd^2	Hughes 140 Setting for 50% Punctures - Lbs
71		203	2.6	10.55
469		202	3.1	11.3
468		205	3.1	11.0
275		200	3.7	11.4
276		202	3.7	11.8
356		202	3.8	9.8
374		201	4.0	9.6
366		205	4.0	9.5
404		202	4.4	10.75
	Avg.	202	3.60	10.63
380		183	4.0	9.25
381		181	4.0	9.75
381		183	4.0	9.2
384		180	4.0	9.0
25		181	4.4	8.5
22		181	4.4	10.3
204		183	5.2	9.9
137		183	6.4	7.75
	Avg.	182	4.55	9.32
232		165	3.6	7.65
234		165	3.6	7.35
242		166	3.6	7.65
260		169	4.5	9.3
252		166	4.5	8.8
257		167	4.5	9.15
262		167	4.5	9.5
	Avg.	166	4.11	8.49
111		148	2.9	6.7
179		152	3.1	9.0
218		147	3.6	7.75
265		152	4.5	7.8
267		153	4.5	8.75
	Avg.	150	3.72	8.00

TABLE 15

Probabilities of Rejecting Bad and Good Fabric with Seyboth Tester Readings in the First and Second Green Bands

A. Reject, as bad, fabric with a mean reading * below the first green band

Mullen Strength of Sample psi	Percent of Samples Rejected as Weakened #1	#2	#3
150	70	65	63
180	42	30	30
210	21	6	9
240	7	.6	1.7

B. Reject, as bad, fabric with a mean reading * below the second green band

Mullen Strength of Sample psi	Percent of Samples Rejected as Weakened #1	#2	#3
150	98.7	98.8	97
180	94	90	86
210	82	63	60
240	60	25	30

* Average of 5 readings.

TABLE 16

Field Tests on Doped-Fabric Surfaces on Aircraft

Fabric code markings: WRAMA-CD4-APD-4 4-24-50

Sample No. 325

Top Surface, tested 9-30-54, 2 PM - Temperature 80° F, R.H. 77%

Mobile AMA Tester #140 setting, lbs:	7.0	7.5
Number of punctures in 10 tries	10	10
Mobile AMA Tester #138 setting, lbs:	7	7.5
Number of punctures in 10 tries	10	10

Seyboth Tester #1	red, red, red, orange, orange
Seyboth Tester #2	orange, orange, red, orange, red
Seyboth Tester #3	red, orange, yellow, red, red
CAA Tester #1750	4 punctures out of 10 tries
CAA Tester #1751	5 punctures out of 10 tries

- -

Sample No. 326

Bottom Surface, tested 9-30-54, 4 PM Temperature 77° F, R.H. 74%

Mobile AMA Tester #140 setting, Lbs:	7.5	8	9	9.5	10	10.5	11	11			
Number of punctures in 10 tries	1	2	1	2	4	6	5	7			
Mobile AMA Tester #138 setting, lbs:	7.5	9.5	10	10.5	10.5	11	11.5	11.5	12		
Number of punctures in 10 tries	0	2	7	4	4	6	9	10	8		

Seyboth Tester #1	Green 1, Green 1, Green 1, Green 2, Green 1
Seyboth Tester #2	Green 2, Green 2, Green 1, Green 1, Green 2
Seyboth Tester #3	Green 1, Green 1, Green 2, Green 1, Green 1
CAA Tester #1750	0 Punctures out of 10 tries
CAA Tester #1751	1 Punctures out of 10 tries

TABLE 16 (CONTINUED)

Sample No. 327

Bottom surface, tested 10-4-54, 1 PM Temperature 71° F, R.H. 100%

Mobile AMA Tester #140 Setting, Lbs:	7	7	7.5	8	9	10	11
Number of punctures in 10 tries	4	6	8	10	10	10	10

Mobile AMA Tester #138 setting Lbs:	7	7.5	8
Number of punctures in 10 tries	7	9	10

Seyboth Tester #1	Orange, orange, orange, orange, yellow
Seyboth Tester #2	Yellow, yellow, yellow, orange, yellow
Seyboth Tester #3	Orange, yellow, yellow, yellow, orange
CAA Tester #1750	1 puncture out of 10 tries
CAA Tester #1751	5 punctures and 2 incomplete punctures out of 10 tries

- -

Fabric code markings: WRAMA RD-4 CD-6 4-25-49

Sample No. 328

Inboard surface, tested 10-28-54, Temperature 54°, R.H. 42%

Hughes Tester #138 setting, Lbs:	7.0	7.5	8.0	8.5	9.0	9.5	10.0
Number of punctures in 10 tries	1	1	6	8	7	7	10

Hughes Tester #140 setting, Lbs:	8.0	8.5	9.0	9.5	10.0
Number of punctures in 10 tries	1	3	7	5	9

Seyboth Tester #1	Yellow five times
Seyboth Tester #2	Yellow five times
Seyboth Tester #3	Yellow five times
CAA Tester #1750	0 punctures out of 10 tries
CAA Tester #1751	0 punctures out of 10 tries

TABLE 16 (CONTINUED)

B-25 aileron, top, Sample number 333

Fabric code markings: NA CD-4 APD-2 1-21-52
Temperature 70° F, R.H. 33%, tested 12-9-54

Hughes Tester #138 setting, Lbs:	7
Number of punctures in 10 tries	10
Hughes Tester #140 setting, Lbs:	7
Number of punctures in 10 tries	10

Seyboth Tester #1	completely through
Seyboth Tester #2	completely through
Seyboth Tester #3	completely through
CAA Tester #1750	wouldn't function properly
CAA Tester #1751	9 punctures in 10 tries
CAA Tester #2036	7 punctures in 10 tries

- -

B-25 aileron, bottom, Sample number 334

Fabric code markings: Same as above
Temperature, R.H., and date tested same as above.

Hughes Tester #138 setting, Lbs.	8	8.5	9	9.5	10	10.5
Number of punctures in 10 tries			2	4	5	9
Hughes Tester #140 setting, Lbs.	8	8.5	9	9.5	10	10.5
Number of punctures in 10 tries	1	6	10			

Seyboth Tester #1	Yellow five times
Seyboth Tester #2	Yellow five times
Seyboth Tester #3	Yellow five times
CAA Tester #1750	wouldn't function properly
CAA Tester #1751	0 punctures, 0 cracks in ten tries
CAA Tester #2036	0 punctures, 0 cracks in ten tries

TABLE 16 (CONTINUED)

B-25 elevator, bottom, Sample No. 335

Fabric Code markings: 1100 M & S CD-4 ASPD-2 30 July 53
Temperature 70° F, R.H., 33%, tested 12-9-54

Hughes Tester #138 setting, Lbs:	10	10.5	11	11.5	12
Number of punctures in 10 tries		1	1	4	7

Hughes Tester #140 setting, Lbs:	10	10.5	11	11.5	12
Number of punctures in 10 tries	0	2	5	7	

Seyboth Tester #1	1st green twice, 1st-2nd green three times
Seyboth Tester #2	2nd green twice, 1st-2nd green three times
Seyboth Tester #3	1st green twice, 1st-2nd green three times

CAA Tester #1750	wouldn't function properly
CAA Tester #1751	0 punctures, 2 cracks in ten tries
CAA Tester #2036	0 punctures, 7 cracks in ten tries

B-25 elevator, top, Sample No. 336

Fabric Code markings: same as above
Temperature, R.H., and date tested same as above

Hughes Tester #138 setting, Lbs:	8	8.5	9	9.5	10
Number of punctures in 10 tries	0	0	6	6	10

Hughes Tester #140 setting, Lbs:	8	8.5	9	9.5	10
Number of punctures in 10 tries	0	2	6	10	

Seyboth Tester #1	Yellow twice, 1st green three times
Seyboth Tester #2	2nd green once, 1st green four times
Seyboth Tester #3	1st green five times

CAA Tester #1750	wouldn't function properly
CAA Tester #1751	0 punctures, 2 cracks in ten tries
CAA Tester #2036	0 punctures, 7 cracks in ten tries

TABLE 16 (CONTINUED)

B-25 left outboard rudder, Sample No. 337

Fabric code markings: TO 01-1-12 C/W HAFB 13 APR 53-
220WY Repainted HAM AFB
APD-1 18 Aug 53

Temperature 70° F, R.H. 29%, tested 12-9-54

Hughes Tester #138 setting, Lbs:	7	7.5	8	8.5	9	9.5
Number of punctures in 10 tries				1	5	9

Hughes Tester #140 setting, Lbs:	7	7.5	8	8.5	9	9.5
Number of punctures in 10 tries		0	5	8	9	

Seyboth Tester #1	Yellow five times
Seyboth Tester #2	Yellow-1st green twice, yellow three times
Seyboth Tester #3	Yellow-1st green once, yellow four times
CAA Tester #1750	wouldn't function properly
CAA Tester #1751	0 punctures, 0 cracks in ten tries
CAA Tester #2036	0 punctures, 0 cracks in ten tries

- -

B-25 right inboard rudder, Sample No. 338

Fabric code markings: TO 07-1-23 C/W WP AFB June 54
WF CD-5 CPD-2 Jan 53

Temperature, R.H., and date tested same as above

Hughes Tester #138 setting, Lbs:	9.5	10	10.5	11	11.5
Number of punctures in ten tries	0		3	6	9

Hughes Tester #140 setting, Lbs:	9.5	10	10.5	11	11.5
Number of punctures in ten tries		3	6	8	

Seyboth Tester #1	1st-2nd green once, 1st green once, yellow-1st green twice, yellow once
Seyboth Tester #2	1st green five times
Seyboth Tester #3	1st green five times
CAA Tester #1750	wouldn't function properly
CAA Tester #1751	0 punctures, 0 cracks in ten tries
CAA Tester #2036	0 punctures, 0 cracks in ten tries

TABLE 16 (CONTINUED)

B-25 left inboard rudder, Sample No. 339

Fabric code markings: WF CD-5 APD-2 Jan 53
Redoped APD-2 WFAFB TO 07-23 C/W Mar 54

Temperature 70° F, R.H. 30%, tested 12-9-54

Hughes Tester #138 setting, Lbs:	11	11.5	12
Number of punctures in 10 tries		0	5

Hughes Tester #140 setting, Lbs:	11	11.5	12
Number of punctures in 10 tries	0	1	4

Seyboth Tester #1	2nd green once, 1st green three times yellow-1st green once
Seyboth Tester #2	1st green once, 1st-2nd green four times
Seyboth Tester #3	1st-2nd green three times, 1st green twice
CAA Tester #1750	wouldn't function properly
CAA Tester #1751	0 punctures, 0 cracks in ten tries
CAA Tester #2036	0 punctures, 0 cracks in ten tries

B-25 right aileron, top, Sample No. 340

Fabric code markings: PAFB CD-5 APD-2 10-10-52
Temperature 69° F., R.H. 30%, tester 12-9-54

Hughes Tester #138 setting, Lbs:	10	10.5	11	11.5
Number of punctures in ten tries	2	1	4	10

Hughes Tester #140 Setting, Lbs:	10	10.5	11	11.5
Number of punctures in ten tries	3	3	10	10

Seyboth Tester #1	Yellow-1st green five times
Seyboth Tester #2	1st green five times
Seyboth Tester #3	1st green five times
CAA Tester #1750	wouldn't function properly
CAA Tester #1751	0 punctures, 1 crack in ten tries
CAA Tester #2036	0 punctures, 0 cracks in ten tries

TABLE 16 (CONTINUED)

B-25 right aileron, bottom, Sample No. 341

Fabric code markings: PAFB CD-5 APD-2 10-10-52
Temperature 69° F., R.H. 30%, tested 12-9-54

Hughes Tester #138 setting, Lbs:	10.5	11	11.5	12
Number of punctures in 10 tries		3	6	8

Hughes Tester #140 setting, Lbs:	10.5	11	11.5	12
Number of punctures in 10 tries	1	5	8	

Seyboth Tester #1	1st-2nd green twice, 1st green three times
Seyboth Tester #2	1st-2nd green five times
Seyboth Tester #3	1st-green once, 1st-2nd green four times
CAA Tester #1750	wouldn't function properly
CAA Tester #1751	0 punctures, 0 cracks in ten tries
CAA Tester #2036	0 punctures, 0 cracks in ten tries

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C-82 starboard rudder, inboard, Sample No. 492

Fabric code markings: REC GAFB 4-4-49
CD6 APD3

Temperature 65° F, R.H. 48%, tested 5-12-55
Surface wet from rain

Hughes Tester setting, Lbs:	9	9.5	10	10.5	11
Number of punctures in 10 tries, #133	4	7			
Number of punctures in 10 tries, #138			4	5	9
Number of punctures in 10 tries, #140		2	5	7	

Seyboth Tester #1	GR1-2, YW, YW-GR, GR1 2 times
Seyboth Tester #2	GR1, GR1-2, GR2 3 times
Seyboth Tester #3	GR1, YW, GR2, GR1-2 2 times
CAA Tester #1751	0 punctures, 9 cracks
CAA Tester #2036	0 punctures, 8 cracks

TABLE 16 (CONTINUED)

C-82 starboard rudder, inboard, Sample No. 493

Fabric code markings, temperature, R.H., and date same as above
Surface wet from rain

Hughes Tester setting, Lbs:	10	10.5	11	11.5
Number of punctures in 10 tries, #133	2	8		
Number of punctures in 10 tries, #138	2	5	8	
Number of punctures in 10 tries, #140		1	5	6

Seyboth Tester #1	GR1, GR2 4 times
Seyboth Tester #2	GR2-3, GR2 4 times
Seyboth Tester #3	GR1-2, GR3, GR2 3 times
CAA Tester #1751	0 punctures, 3 cracks
CAA Tester #2036	0 punctures, 2 cracks

C-82 starboard rudder, inboard, Sample No. 494

Fabric code markings: same as above
Temperature 65° F, R.H. 44%, tested 5-12-55
Surface wet from rain

Hughes Tester setting, Lbs:	8	8.5	9	9.5	10
Number of punctures in 10 tries, #133				3	9
Number of punctures in 10 tries, #138	4	7	7		
Number of punctures in 10 tries, #140		4	5		10

Seyboth Tester #1	Orange, YW 2 times, Red 2 times
Seyboth Tester #2	Red 2 times, YW 3 times
Seyboth Tester #3	Orange, through, YW 3 times
CAA Tester #1751	0 punctures, 0 cracks
CAA Tester #2036	0 punctures, 0 cracks

TABLE 16 (CONTINUED)

C-82 port rudder, inboard, Sample No. 495

Fabric code markings same as above
Surface wet from rain
Temperature 68° F, R.H. 42%, tested 5-12-55

Hughes Tester setting, Lbs.	10	10.5	11	11.5	12
Number of punctures in 10 tries, #133	2	4	8		
Number of punctures in 10 tries, #138			5	7	8
Number of punctures in 10 tries, #140		0		2	6

Seyboth Tester #1	GR3, GR2 4 times
Seyboth Tester #2	GR3 2 times, GR2 3 times
Seyboth Tester #3	GR3, GR2 4 times

CAA Tester #1751	0 punctures, 1 crack
CAA Tester #2036	0 punctures, 1 crack

- -

C-82 port rudder, inboard, Sample No. 496

Fabric code markings same as above
Temperature 68° F, R.H. 42%, tested 5-12-55
Surface wet from rain

Hughes Tester setting, Lbs:	10.5	11	11.5
Number of punctures in 10 tries, #133	5	7	
Number of punctures in 10 tries, #138	2	7	8
Number of punctures in 10 tries, #140	3	5	

Seyboth Tester #1	GR2 5 times
Seyboth Tester #2	GR2 5 times
Seyboth Tester #3	GR2 2 times, GR3 3 times

CAA Tester #1751	0 punctures, 1 crack
CAA Tester #2036	0 punctures, 0 crack

TABLE 16 (CONTINUED)

C-82 port rudder, inboard, Sample No. 497

Fabric code markings same as above
Temperature 70° F, R.H. 36%, tested 5-12-55
Surface wet from rain

Hughes Tester setting, Lbs:	10	10.5	11
Number of punctures in 10 tries, #133	1	7	
Number of punctures in 10 tries, #138	0	6	7
Number of punctures in 10 tries, #140		4	8

Seyboth Tester #1	GR3, GR2 4 times
Seyboth Tester #2	GR2-3, GR2 4 times
Seyboth Tester #3	GR2-3 2 times, GR2 3 times
CAA Tester #1751	0 punctures, 0 cracks
CAA Tester #2036	0 punctures, 0 cracks

C-82 port rudder, outboard, Sample No. 498

Fabric code markings same as above
Temperature 70° F, R.H. 36%, tested 5-12-55
Surface wet from rain

Hughes Tester Setting, Lbs:	9.5	10	10.5	11
Number of punctures in 10 tries, #133	5	7		
Number of punctures in 10 tries, #138	4	5	9	
Number of punctures in 10 tries, #140	4	6		9

Seyboth Tester #1	YW-GR, GR1, GR1-2, GR2 2 times
Seyboth Tester #2	GR1, GR1-2, GR2 3 times
Seyboth Tester #3	GR1, GR1-2 2 times, GR2 2 times
CAA Tester #1751	0 punctures, 4 cracks
CAA Tester #2036	0 punctures, 1 crack

TABLE 16 (CONTINUED)

C-82 port rudder, outboard, Sample No. 499

Fabric code markings same as above
Temperature 71° F, R.H. 33%
Surface wet from rain

Hughes Tester setting, Lbs:	7.5	8	8.5	9
Number of punctures in 10 tries, #133		4	5	
Number of punctures in 10 tries, #138	0		5	7
Number of punctures in 10 tries, #140		3	5	9

Seyboth Tester #1	YW-GR, YW 2 times, GR2 2 times
Seyboth Tester #2	GR1 2 times, YW 2 times
Seyboth Tester #3	YW-GR, GR1 2 times, YW 2 times
CAA Tester #1751	0 punctures, 1 crack
CAA Tester #2036	0 punctures, 2 cracks

- -

C-82 port rudder, outboard, Sample No. 500

Fabric code markings same as above
Temperature 71° F, R.H. 33%, tested 5-12-55
Surface wet from rain

Hughes Tester setting, Lbs:	7	7.5	8	8.5	9
Number of punctures in 10 tries, #133	3	5	7		
Number of punctures in 10 tries, #138		3	5		9
Number of punctures in 10 tries, #140			4	6	

Seyboth Tester #1	GR1, YW-GR, YW 3 times
Seyboth Tester #2	YW-GR, YW 4 times
Seyboth Tester #3	YW-GR, GR2, YW 3 times
CAA Tester #1751	1 puncture, 7 cracks
CAA Tester #2036	0 punctures, 1 crack

TABLE 16 (CONTINUED)

C-82 outboard starboard aileron, top, sample 501 Fabric code markings same as above. Tested 6-13-55

Temperature 55½° F, R.H. 80%, surface wet from rain

Hughes Tester setting, Lbs:	7.5	8	8.5
Number of punctures in 10 tries, #133	4	7	
Number of punctures in 10 tries, #138			
Number of punctures in 10 tries, #140		5	8

Seyboth Tester #1	Orange, Orange-YW, YW 3 times
Seyboth Tester #2	Orange-YW 2 times, YW 3 times
Seyboth Tester#3	YW five times
CAA Tester #1751	0 punctures, 0 cracks
CAA Tester #2036	0 punctures, 0 cracks

TABLE 17

Mullen Burst Tests on Field-Tested Samples

Temperature: 70° F
Relative Humidity: 65%

Sample	Mullen Burst Tester Readings, psi						Avg. Mullen Strength, psi
325	125	116	119	112	113		117
326	190	172	177	191	188		184
327	141	154	132	150	144		144
328	127	134	151	148	176		147
333	113	113	111	146	139		124
334	208	219	215	219	232		219
335	363	319	338	344	285		330
336	174	193	180	191	198		187
337	235	228	216	212	205		219
338	278	230	353	284	270		283
339	242	294	300	324	215		264
340	238	253	225	217	200		227
341	344	320	305	300	313		316
492	200	190	148	-	-		180
493	200	184	105	-	-		163
494	148	109	150	114	-		130
495	173	154	157	187	173		169
496	144	166	158	169	183		164
497	218	197	163	199	184		192
498	198	154	142	161	182	187	171
499	155	162	142	-	-		171
500	195	127	195	167	-		153
501	204	164	191	231	151		188

TABLE 18

Corrected Field-Test Readings and Mullen Burst Strengths for the Same Doped-Fabric Samples

A. Hughes Tester

Sample No.	Mullen Strength psi	Corrected Hughes Tester Reading - Lbs 133	138	140
325	128	*	<7	<7
326	193	*	9.55	10.05
327	157	*	<7	<7
328	147	*	8.15	9.0
333	124	*	<7	<7
334	219	*	10.6	9.0
335	330	*	12.25	11.7
336	187	*	9.7	9.4
337	219	*	9.6	8.6
338	283	*	11.4	10.95
339	264	*	12.6	12.8
340	227	*	11.7	11.2
341	316	*	11.9	11.6
492	180	8.25	9.6	9.1
493	163	9.35	9.6	10.1
494	130	8.75	7.25	8.1
495	169	9.6	10.1	11.0
496	164	9.6	9.9	10.1
497	192	9.45	9.6	9.7
498	171	8.6	9.1	8.85
499	171	6.6	7.1	7.35
500	153	7.6	7.6	7.6
501	188	6.75	7.1	7.2

* Hughes Tester 133 had not been received when these tests were made.

TABLE 18 (CONTINUED)

B. Seyboth Tester

Sample No.	Mullen Strength psi	Mean Tester Reading #1	#2	#3
325	128	Orange-Red (-)	Orange-Red (+)	Red (+)
326	193	GR1 (+)	GR1-2 (+)	GR1 (+)
327	157	Orange (+)	YW (-)	Orange-YW (+)
328	147	YW	YW	YW
333	124	-	-	-
334	219	YW (+)	YW (+)	YW (+)
335	330	GR1-2 (-)	GR1-2 (+)	GR1-2 (-)
336	187	YW-GR (-)	GR1 (+)	GR1
337	219	YW	YW (+)	YW (+)
338	283	YW-GR	GR1	GR1
339	264	GR1	GR1-2 (-)	GR1-2 (-)
340	227	YW-GR	GR1	GR1
341	316	GR1 (+)	GR1-2	GR1-2
492	180	GR1 (-)	GR1-2 (+)	GR1-2
493	163	GR2 (-)	GR2	GR2
494	130	Orange	Orange (+)	Orange
495	169	GR2	GR2 (+)	GR2
496	164	GR2	GR2	GR3 (-)
497	192	GR2	GR2	GR2 (+)
498	171	GR1-2	GR1-2 (+)	GR1-2 (+)
499	171	YW (+)	YW (+)	YW (+)
500	153	YW-GR	YW-GR (-)	YW-GR
501	188	Orange-YW (+)	Orange-YW (+)	YW

TABLE 18 (CONTINUED)

C. CAA Tester

Sample No.	Mullen Strength psi	No. of Holes in Ten Trials 1750	1751	2036
325	128	4	5	
326	193	0	1	
327	157	1	5	
328	147	0	0	
333	124	*	9	7
334	219	*	0	0
335	330	*	0	0
336	187	*	0	0
337	219	*	0	0
338	283	*	0	0
339	264	*	0	0
340	227	*	0	0
341	316	*	0	0
492	180	*	0	0
493	163	*	0	0
494	130	*	0	0
495	169	*	0	0
496	164	*	0	0
497	192	*	0	0
498	171	*	0	0
499	171	*	1	0
500	153	*	0	0
501	188	*	0	0

* CAA Tester 1750 did not function properly for reasons stated on page (18) of this report.

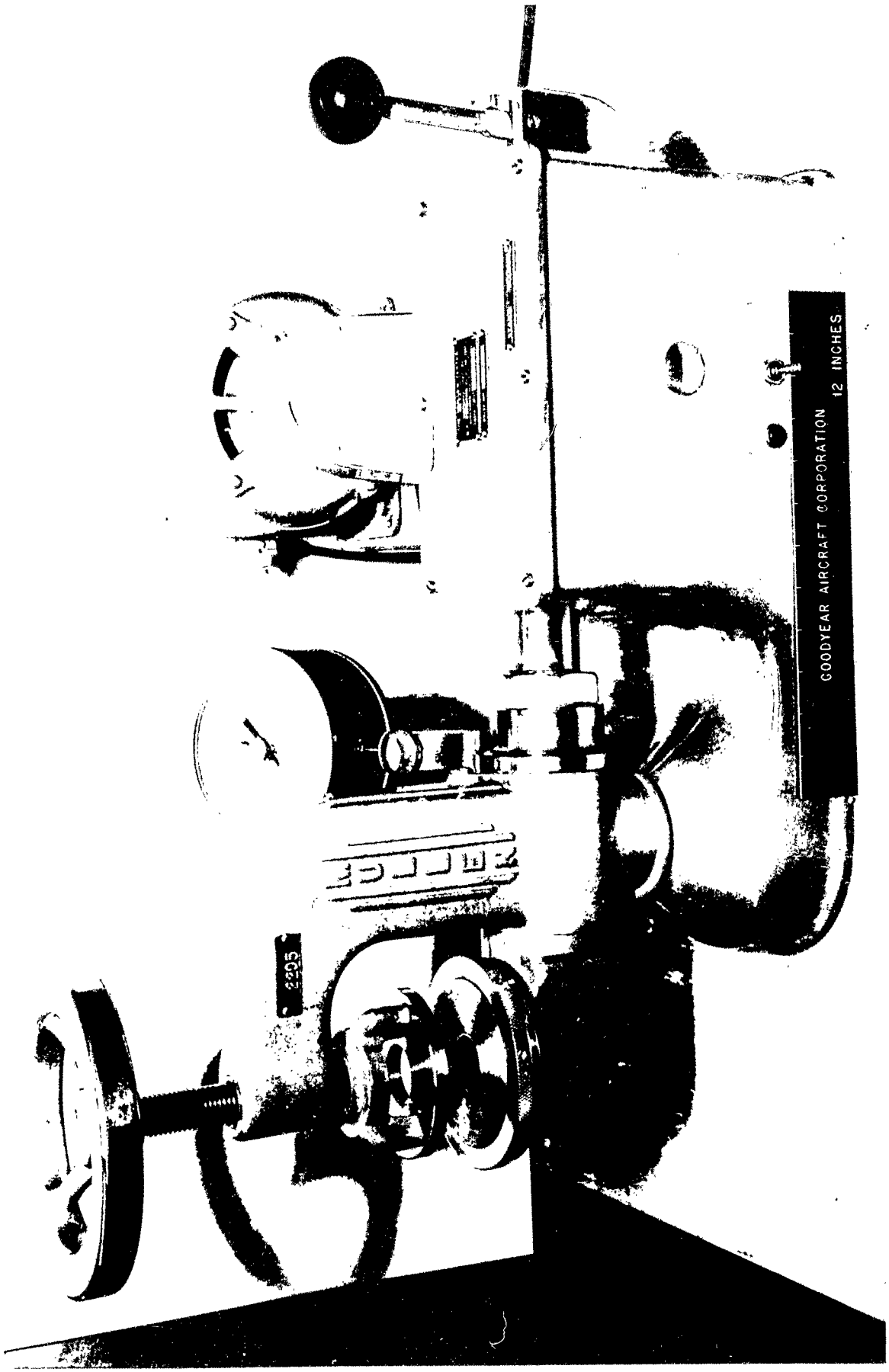


Figure 1 - Mullen Burst Tester

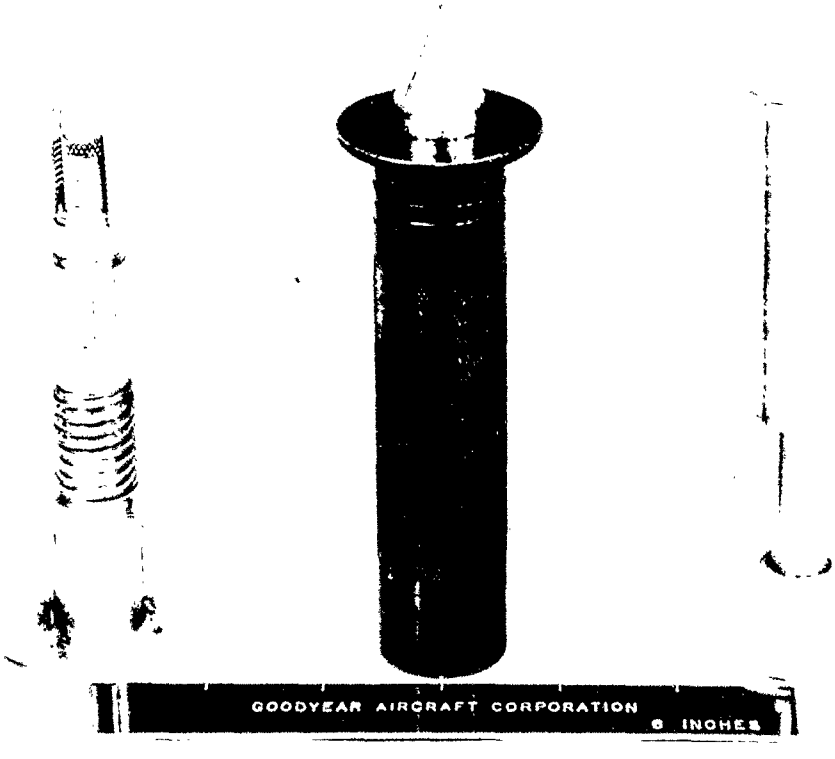
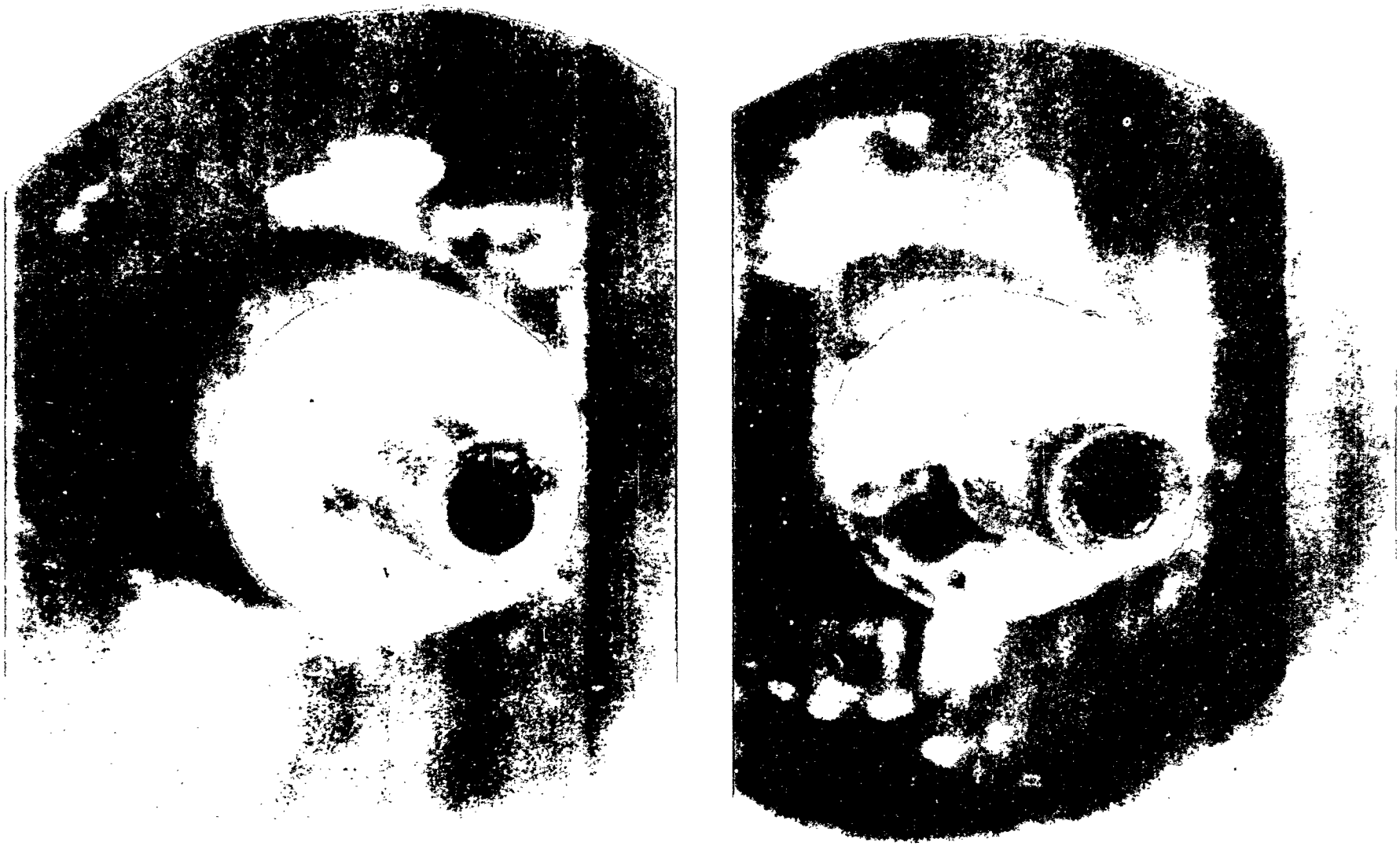


Figure 2 - Mobile AMA (Hughes) Tester, Seyboth Fabric Tester, & CAA Impact Tester



Before After

Figure 3 - Tip of Hughes Tester 140 Before and After Use

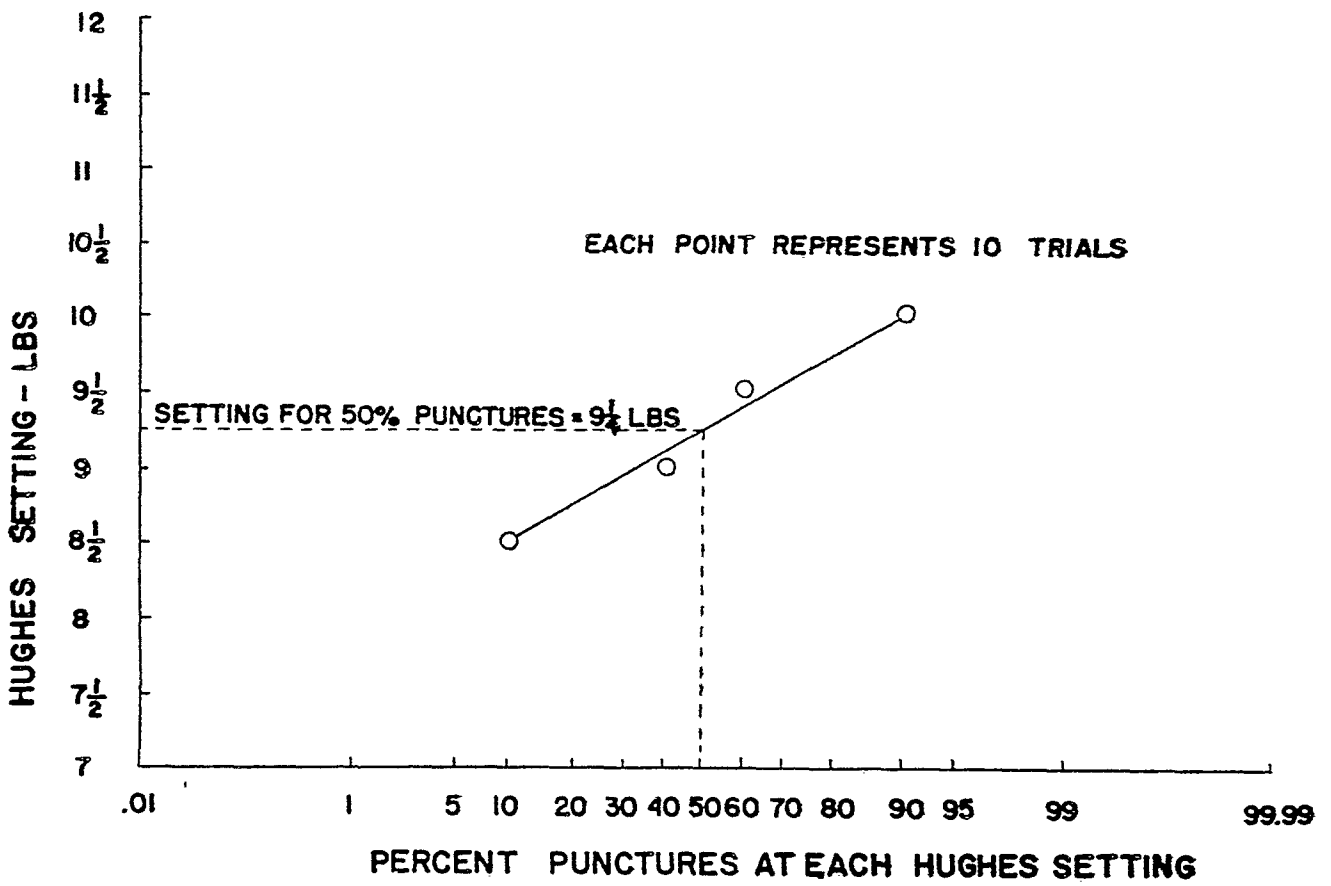


FIG. 4 DETERMINATION OF HUGHES SETTING FOR 50% PUNCTURES

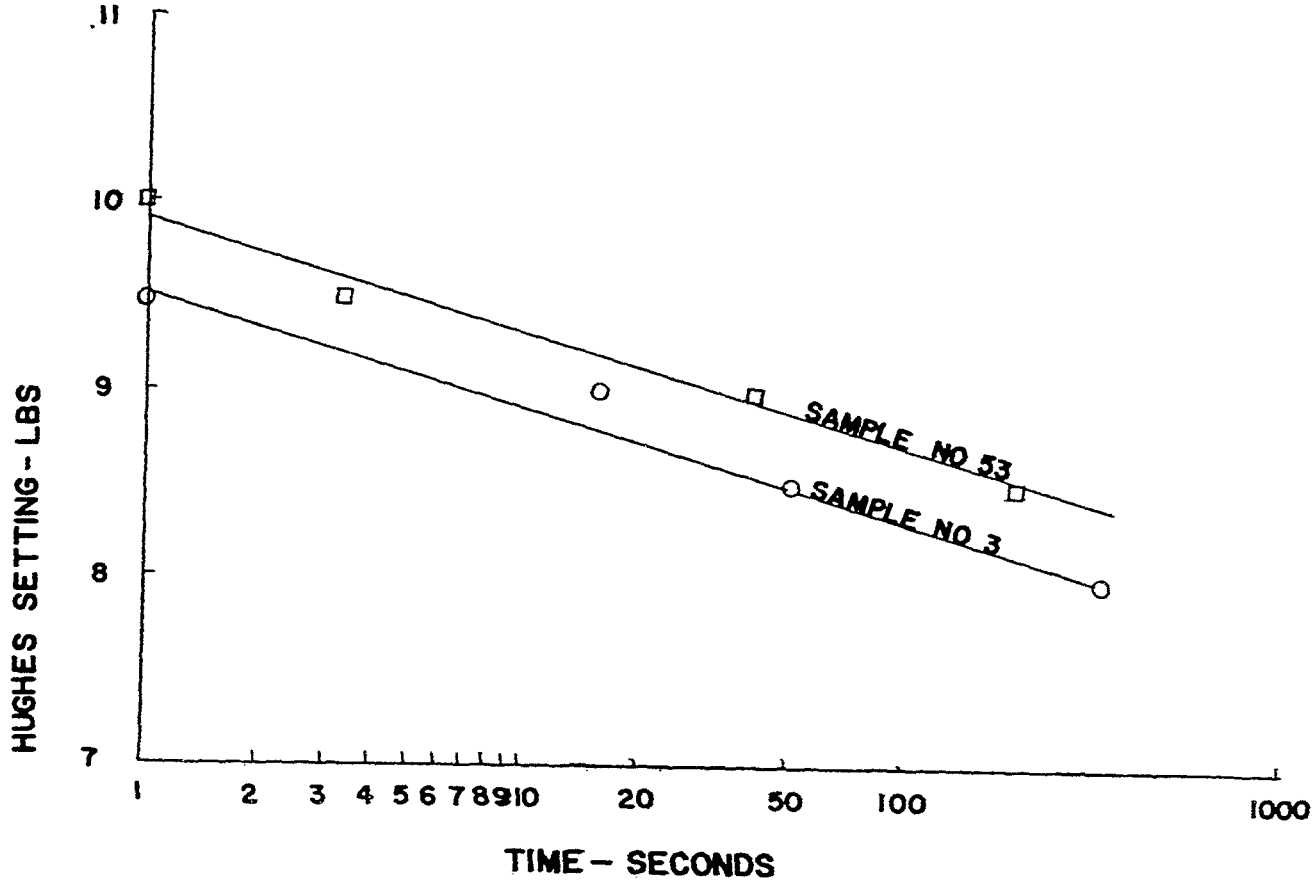


FIG. 5 TIME TO PUNCTURE FOR DIFFERENT HUGHES SETTINGS

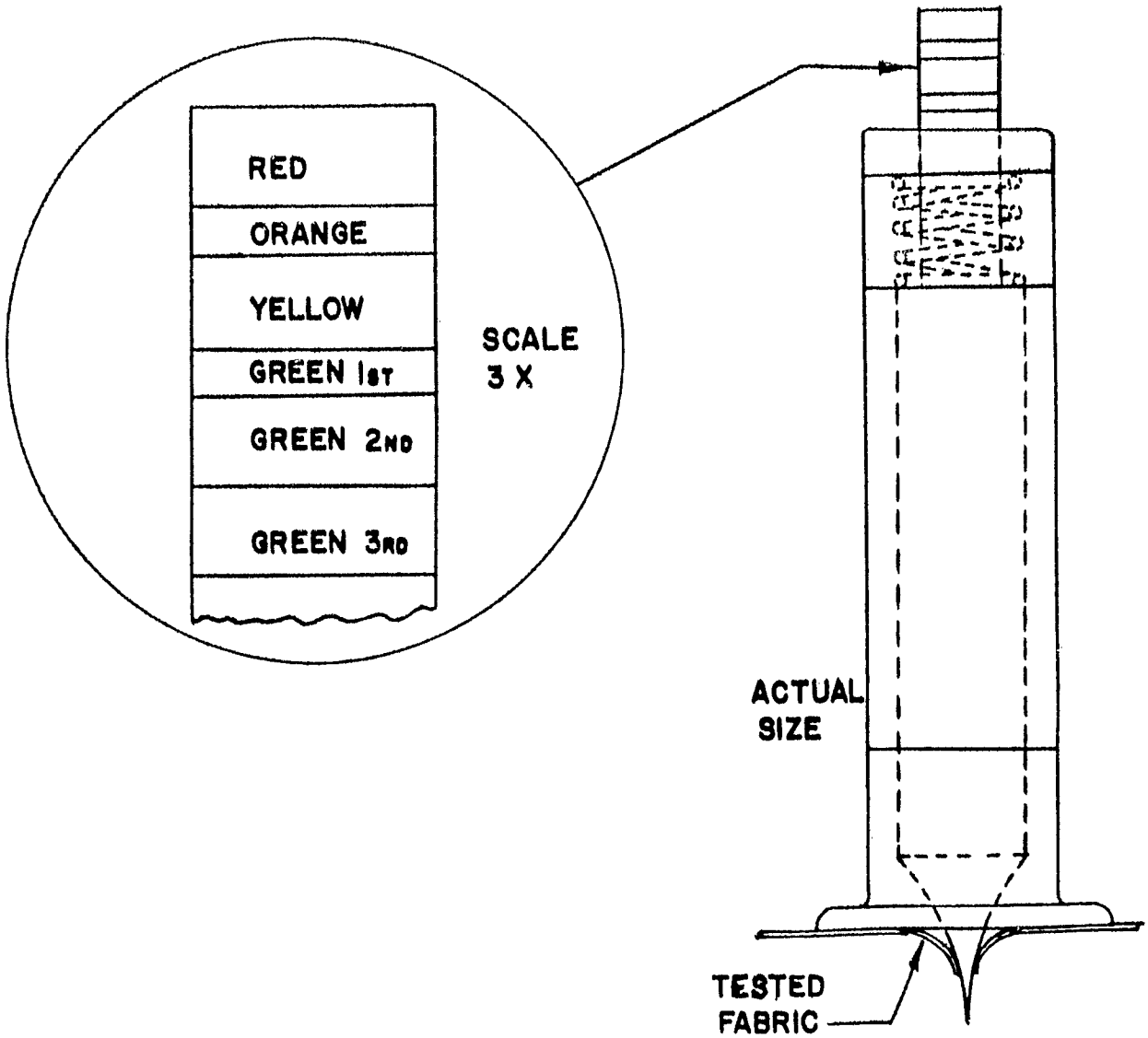


FIG. 6 SEYBOTH FABRIC TESTER

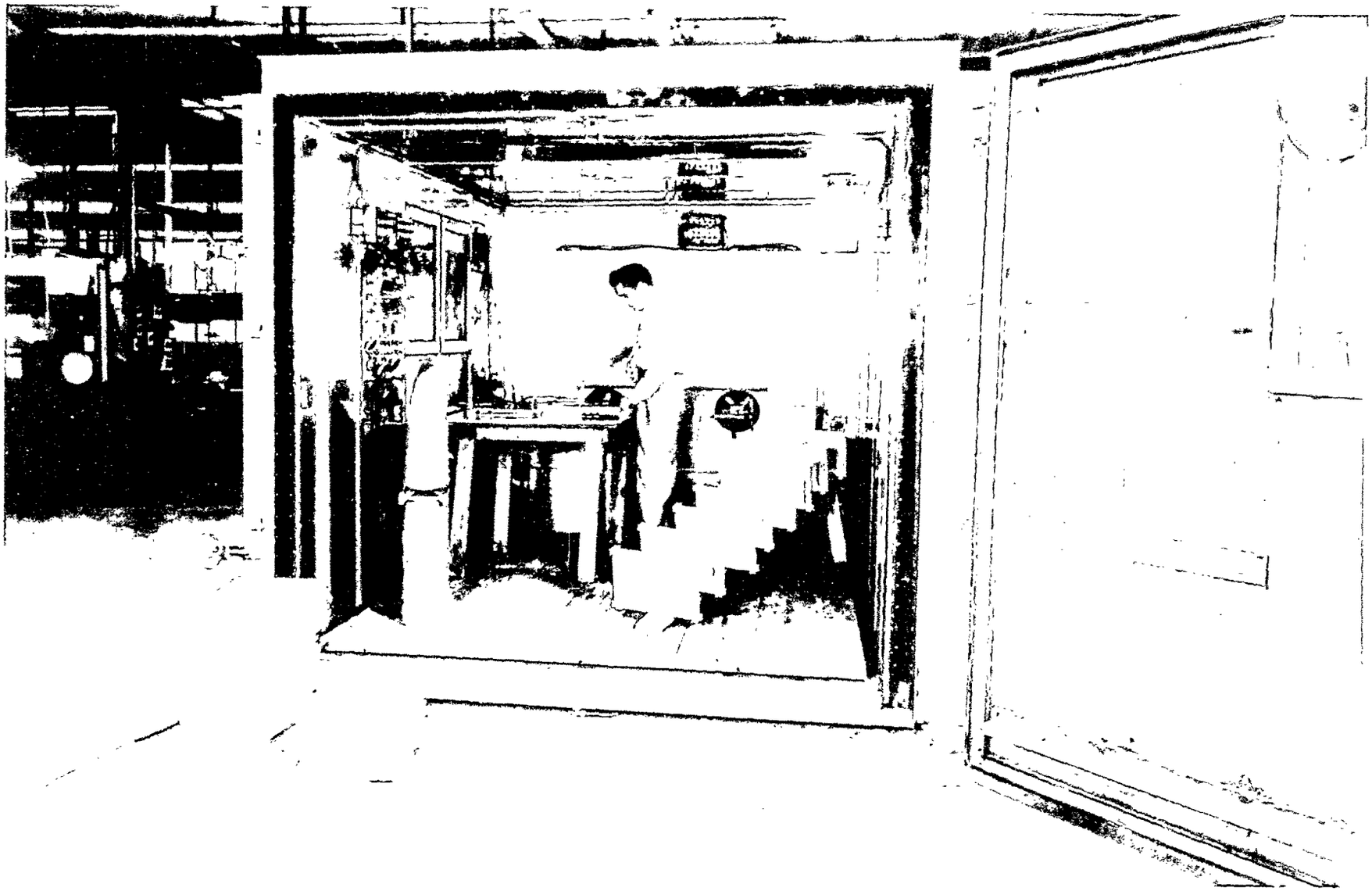


Figure 7 - Environmental Test Chamber, Door Open

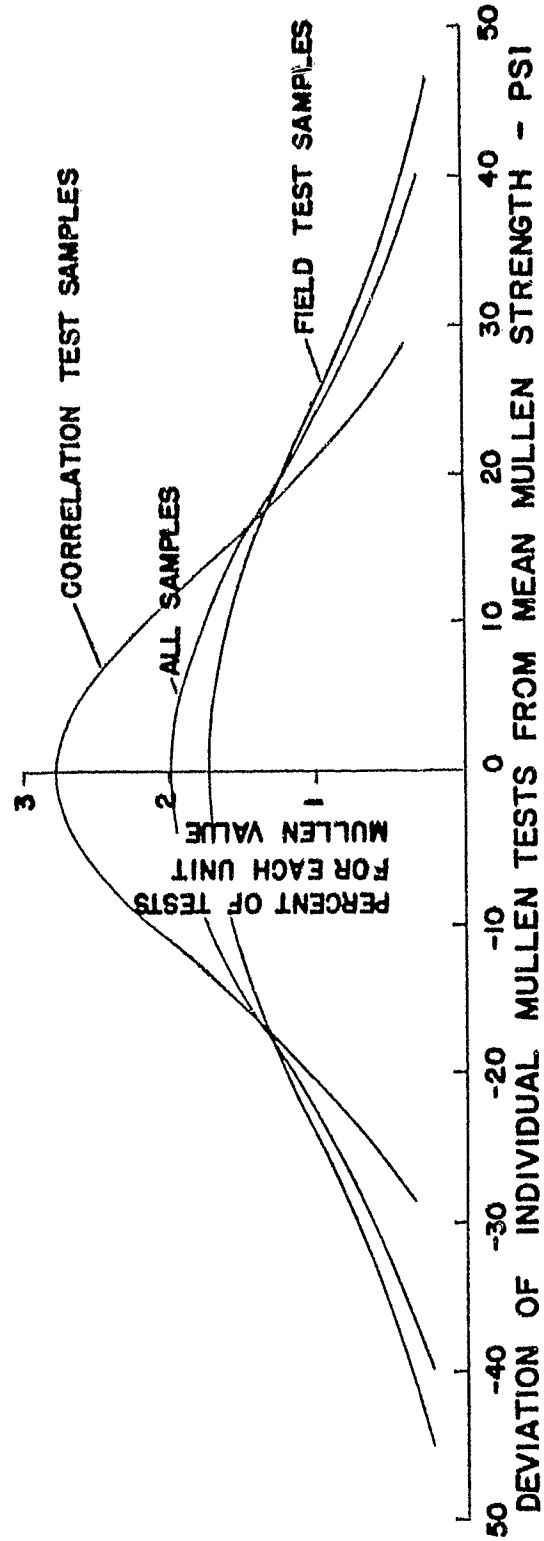


FIG. 8 VARIABILITY OF STRENGTH ON 8½ X 12 DOPED-FABRIC SAMPLES.

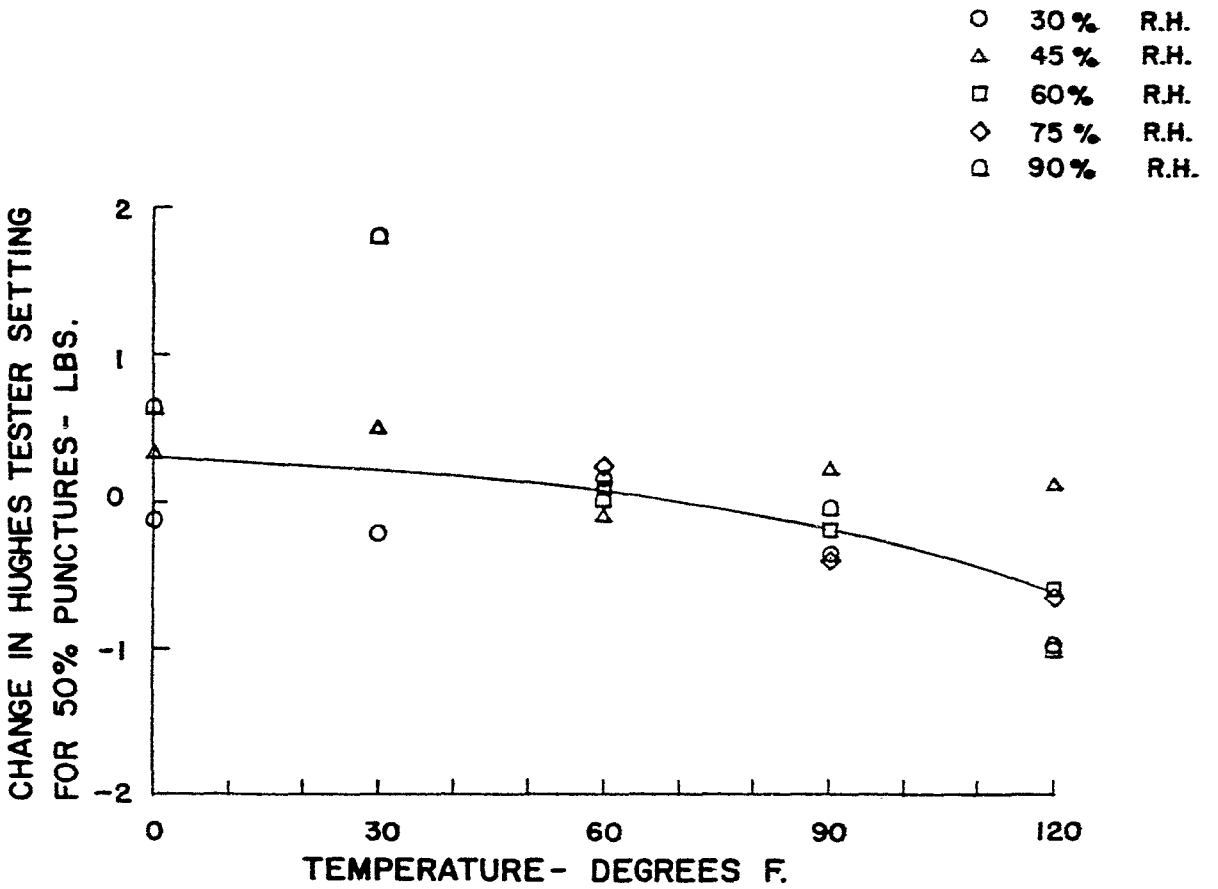


FIG. 9 CHANGE IN HUGHES TESTER SETTING FOR 50% PUNCTURES FOR DIFFERENT TEMPERATURES

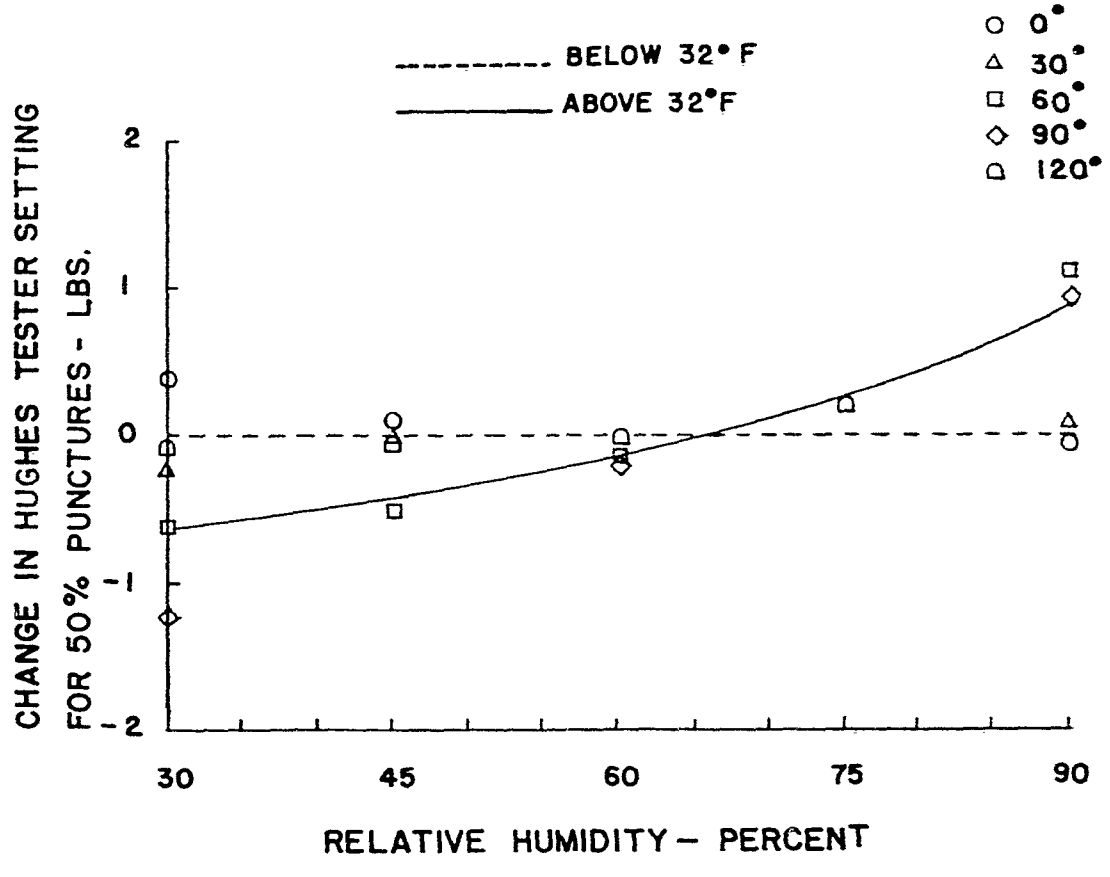


FIG 10 CHANGE IN HUGHES TESTER SETTING FOR 50% PUNCTURES FOR DIFFERENT RELATIVE HUMIDITIES

Fig. 11 RECOMMENDED HUGHES TESTER SETTINGS FOR DIFFERENT TEMPERATURES AND RELATIVE HUMIDITIES

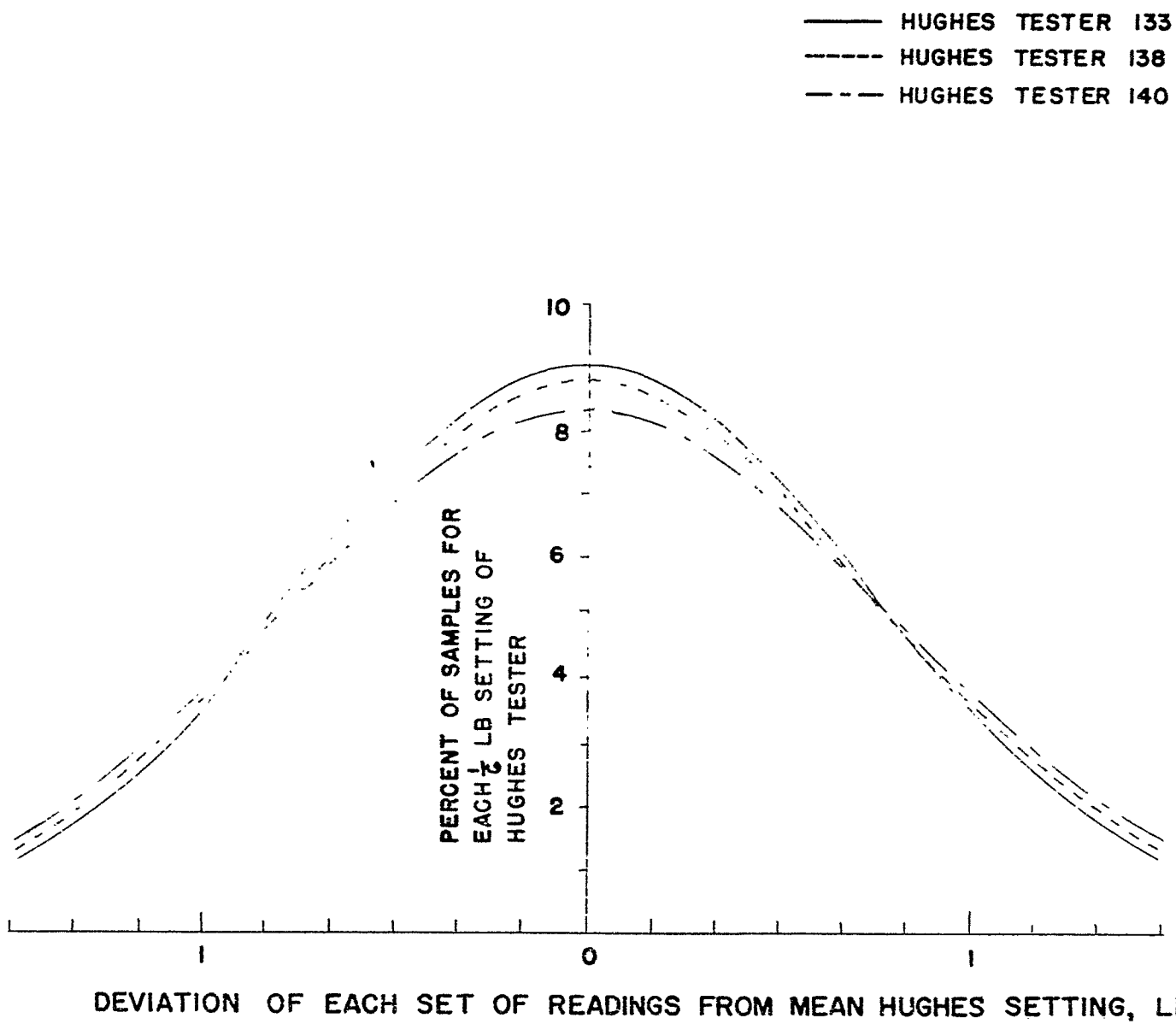


FIG. 12 DISTRIBUTION OF HUGHES TESTER READINGS ABOUT EACH CORRELATION LINE.

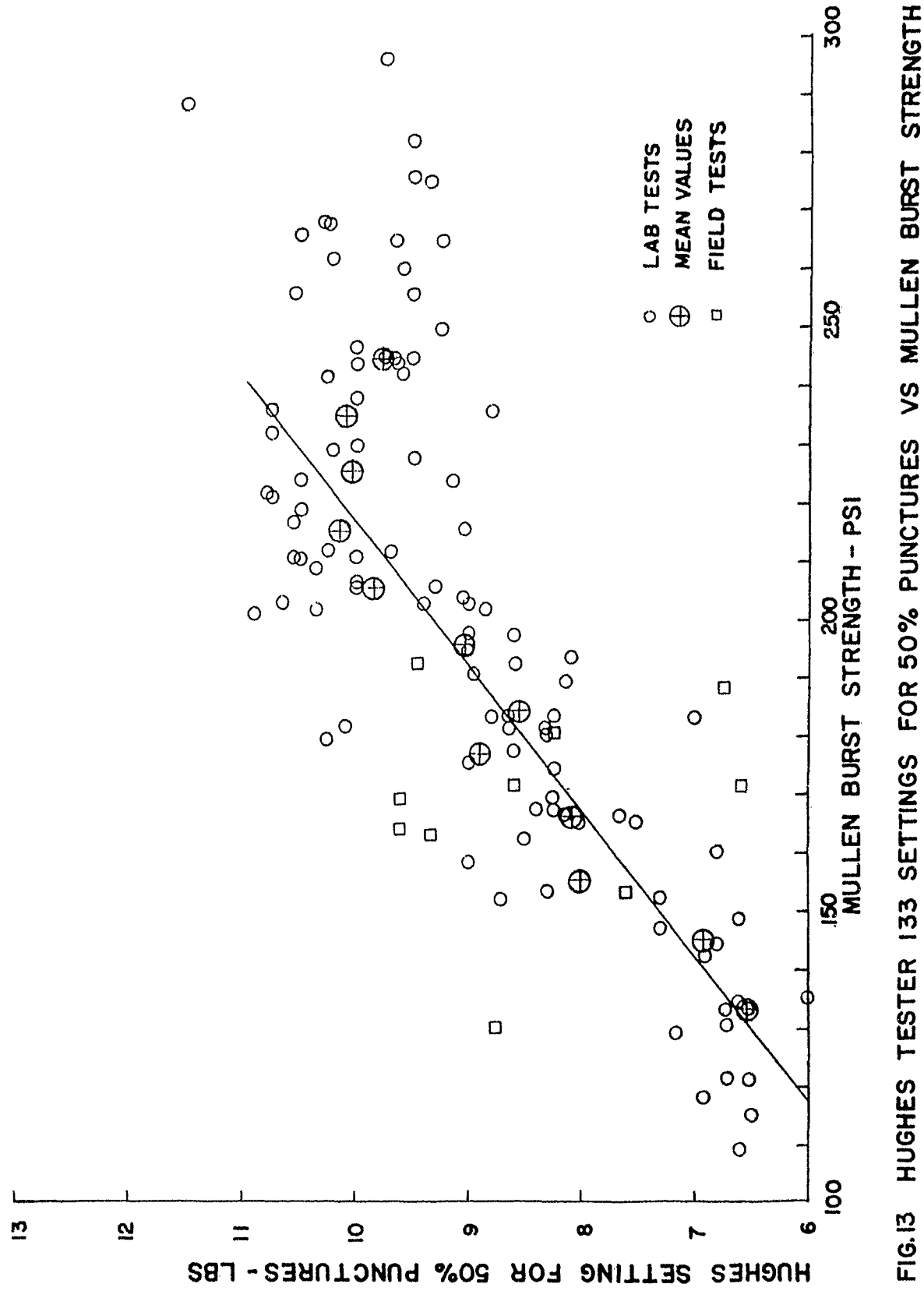


FIG.13 HUGHES TESTER 133 SETTINGS FOR 50% PUNCTURES VS MULLEN BURST STRENGTH FOR THE SAME SAMPLES

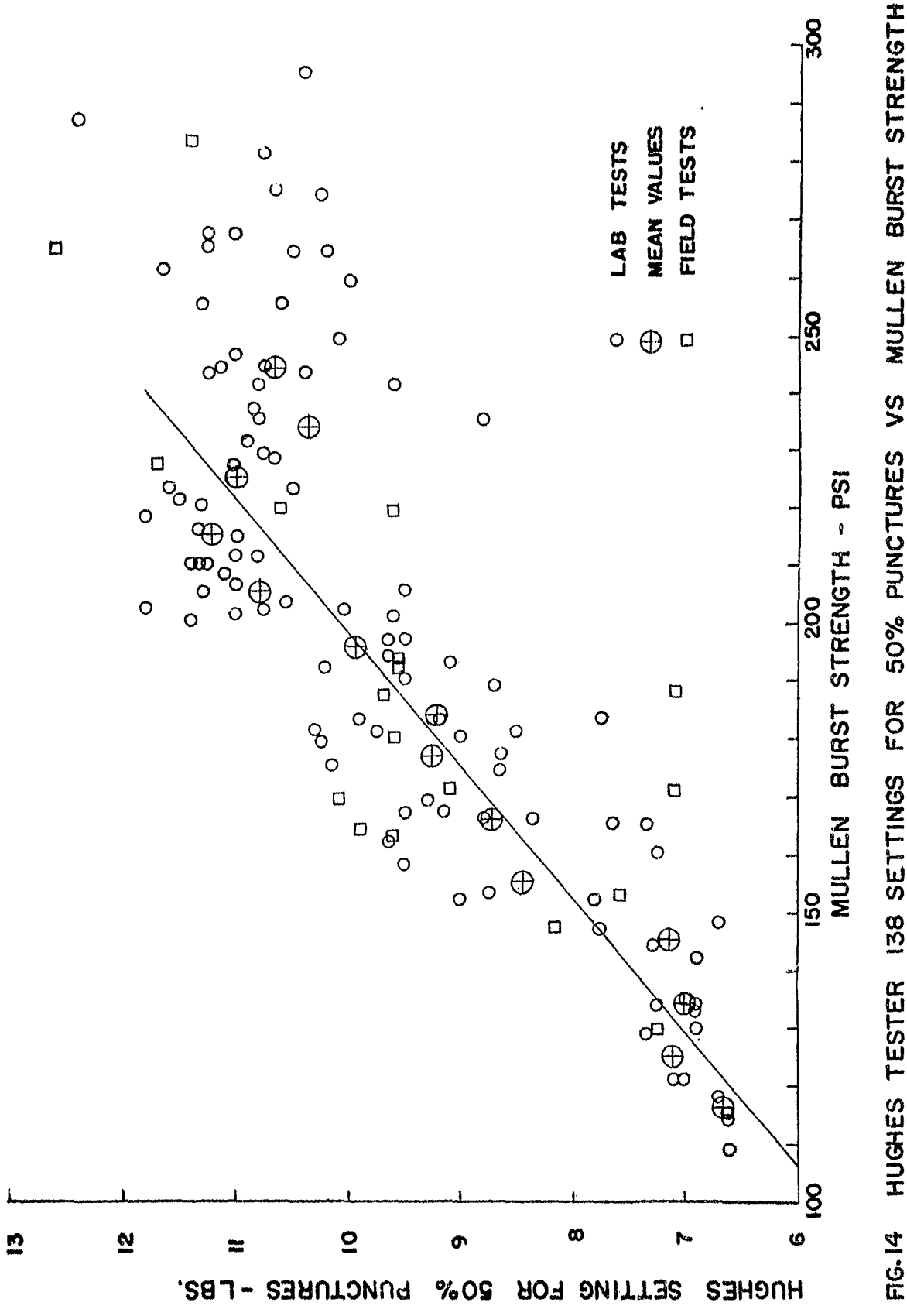


FIG. 14 HUGHES TESTER 138 SETTINGS FOR 50% PUNCTURES VS MULLEN BURST STRENGTH FOR THE SAME SAMPLES

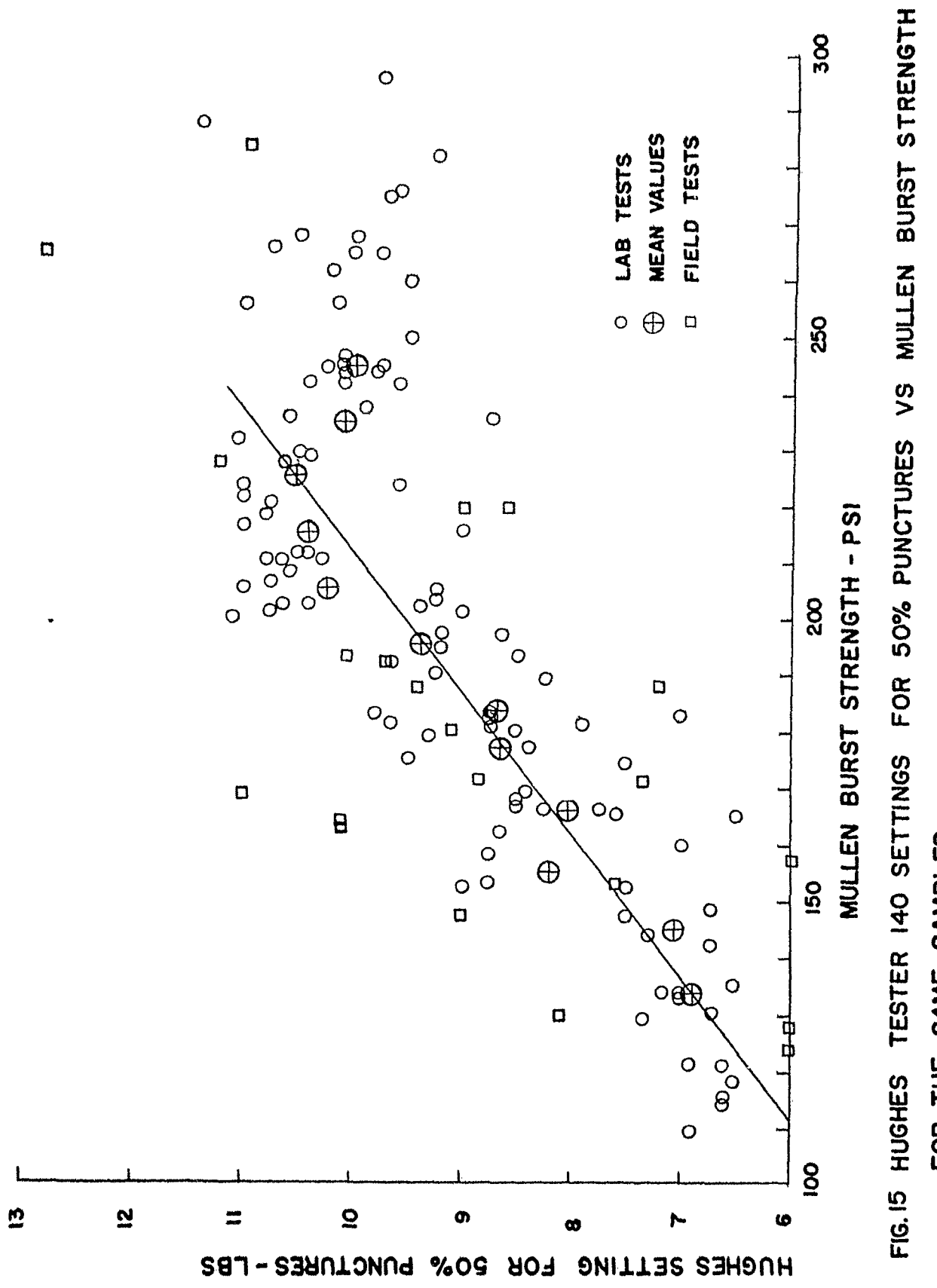


FIG. 15 HUGHES TESTER 140 SETTINGS FOR 50% PUNCTURES VS MULLEN BURST STRENGTH FOR THE SAME SAMPLES

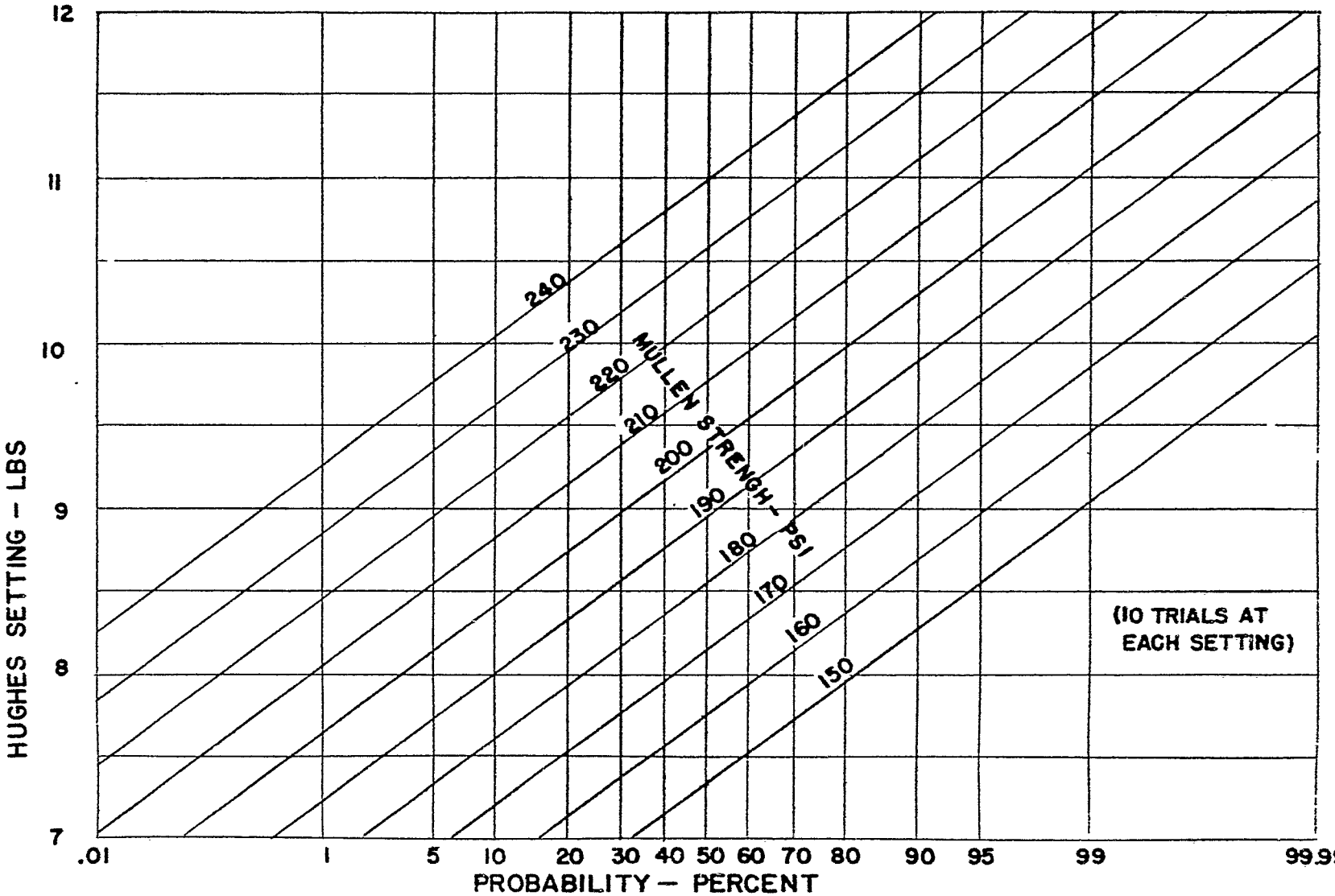


FIG. 16 PROBABILITIES OF 50% PUNCTURES WITH HUGHES TESTER 133 AT DIFFERENT SETTINGS FOR SAMPLES OF DIFFERENT MULLEN STRENGTHS

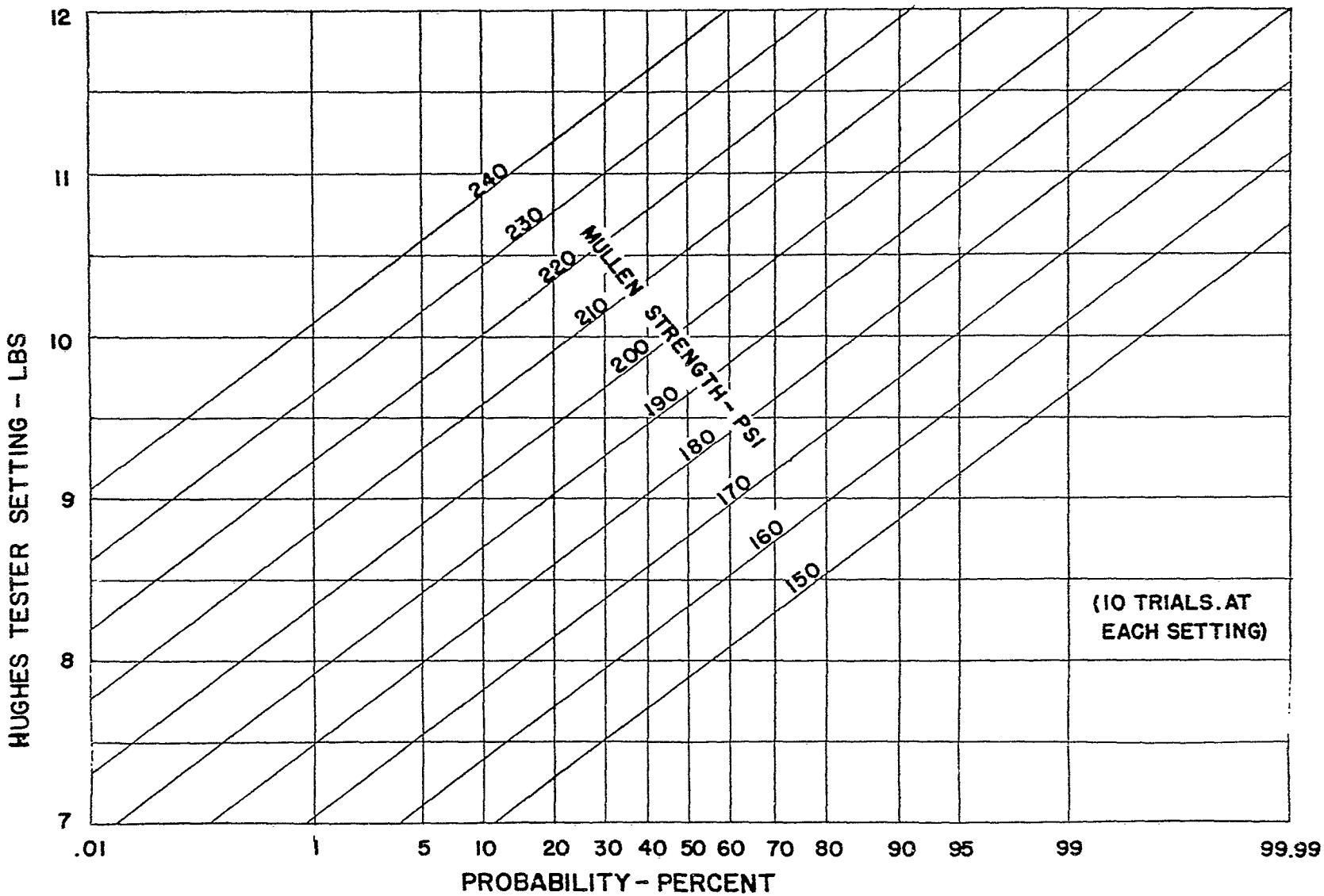


FIG. 17 PROBABILITIES OF 50% PUNCTURES WITH HUGHES TESTER 138 AT DIFFERENT SETTINGS FOR SAMPLES OF DIFFERENT MULLEN STRENGTHS

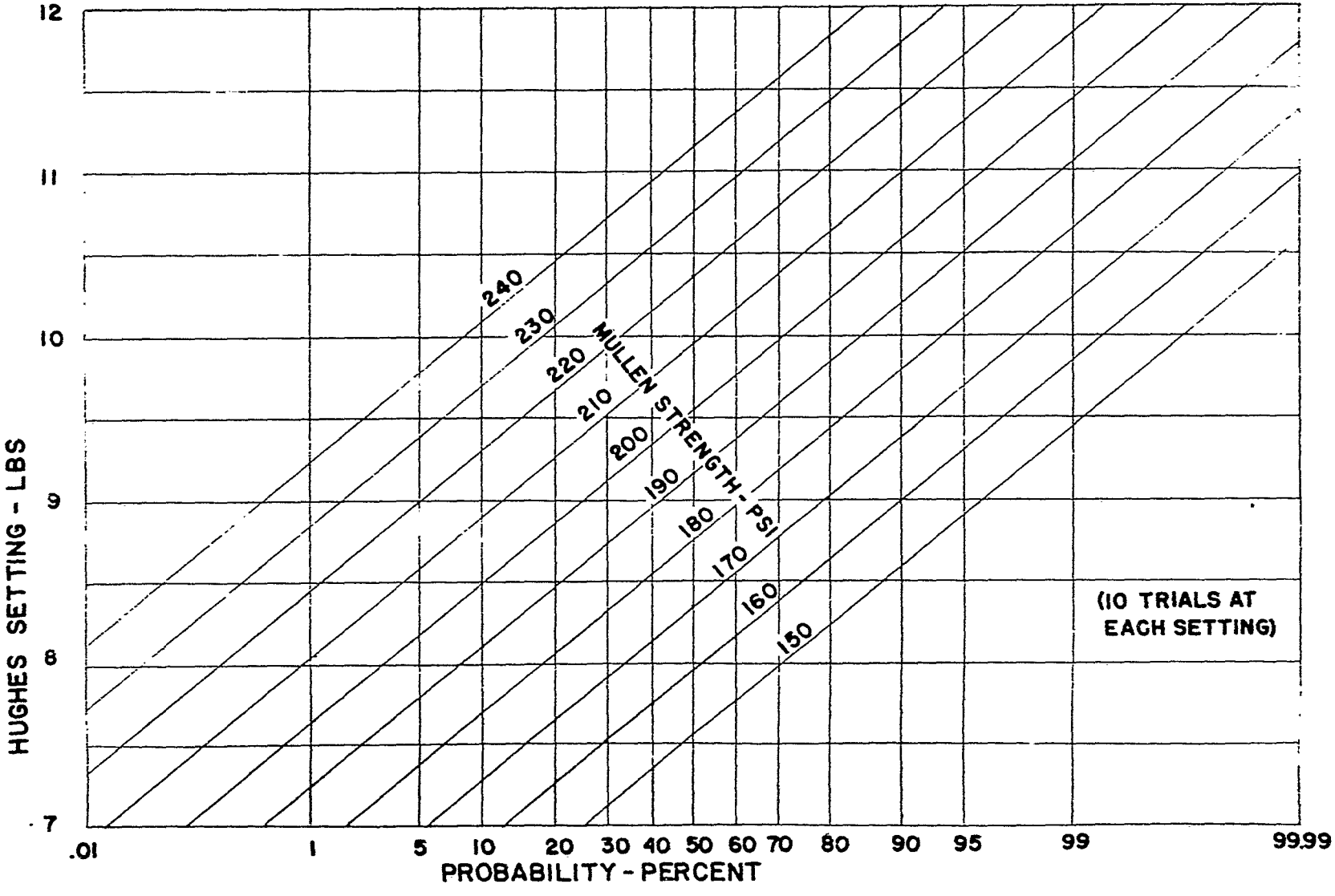


FIG. 18 PROBABILITIES OF 50% PUNCTURES WITH HUGHES TESTER 140 AT DIFFERENT SETTINGS FOR SAMPLES OF DIFFERENT MULLEN STRENGTHS

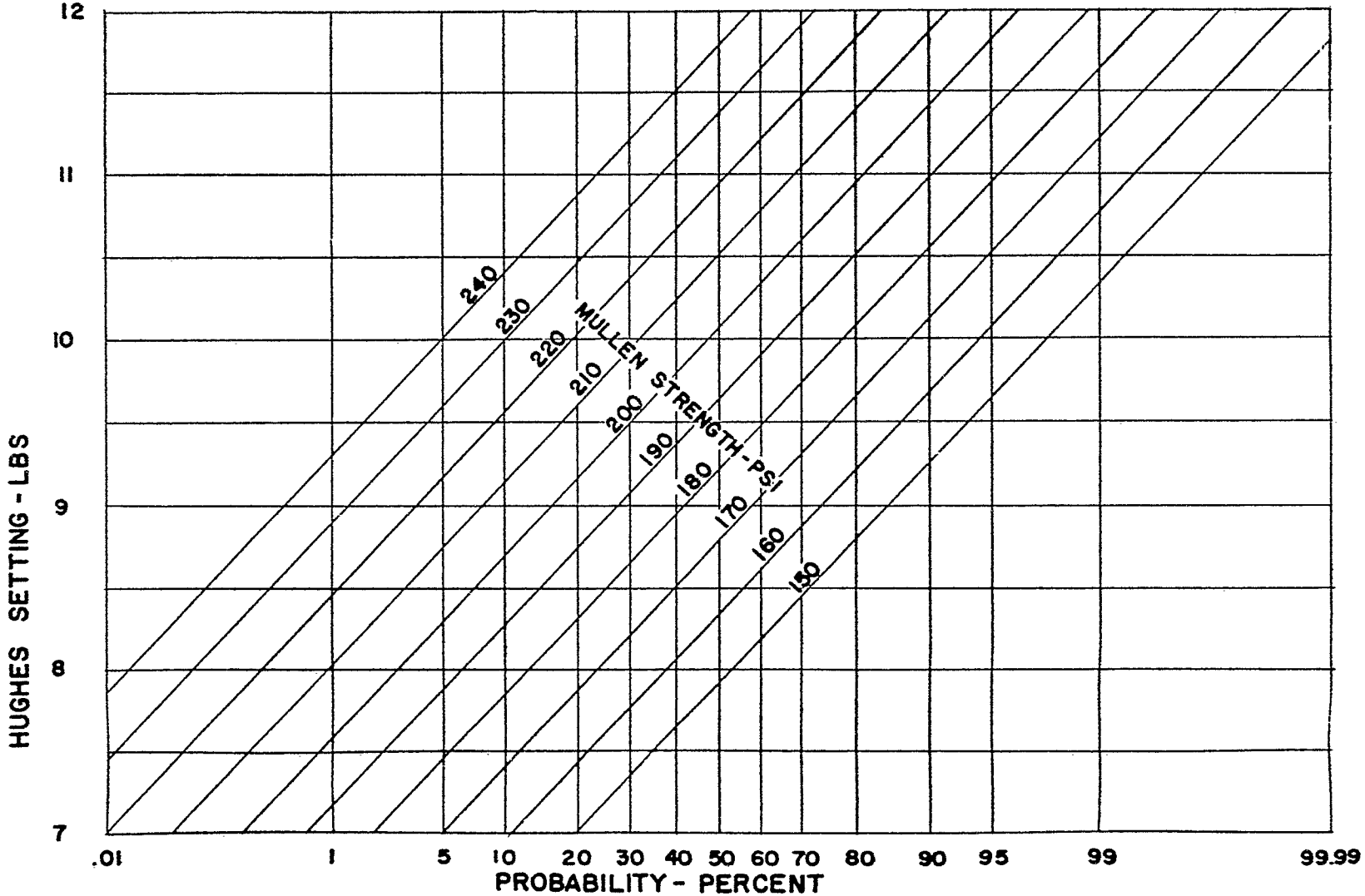


FIG. 19 PROBABILITIES OF 50% PUNCTURES WITH HUGHES TESTER 138 AT DIFFERENT SETTINGS FOR SAMPLES OF DIFFERENT MULLEN STRENGTHS WITH 5 TRIALS AT EACH SETTING

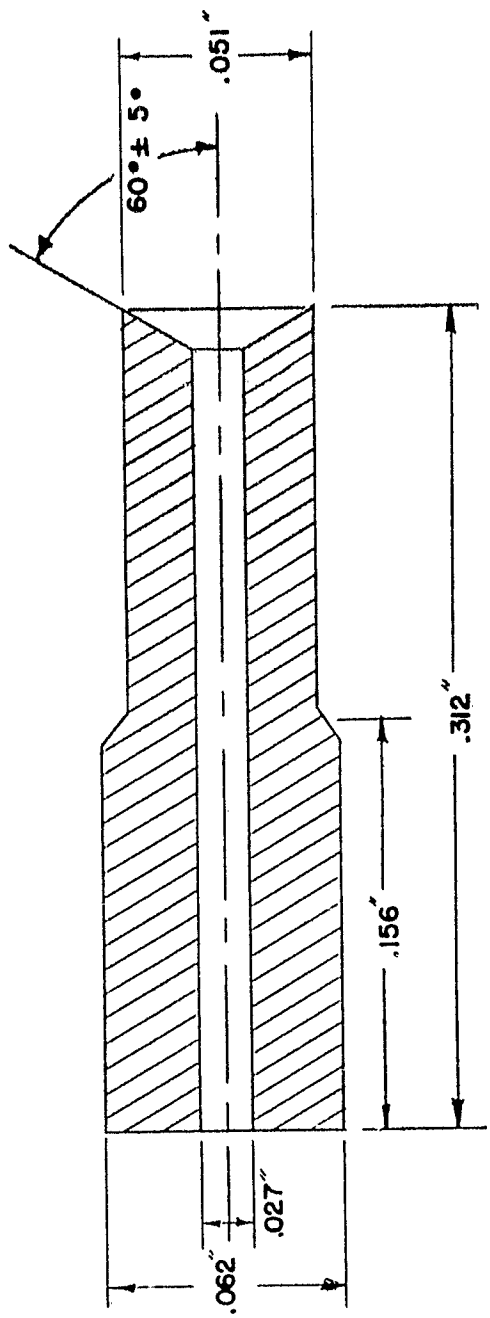


FIG. 20 DIMENSIONS OF HUGHES TESTER TIP

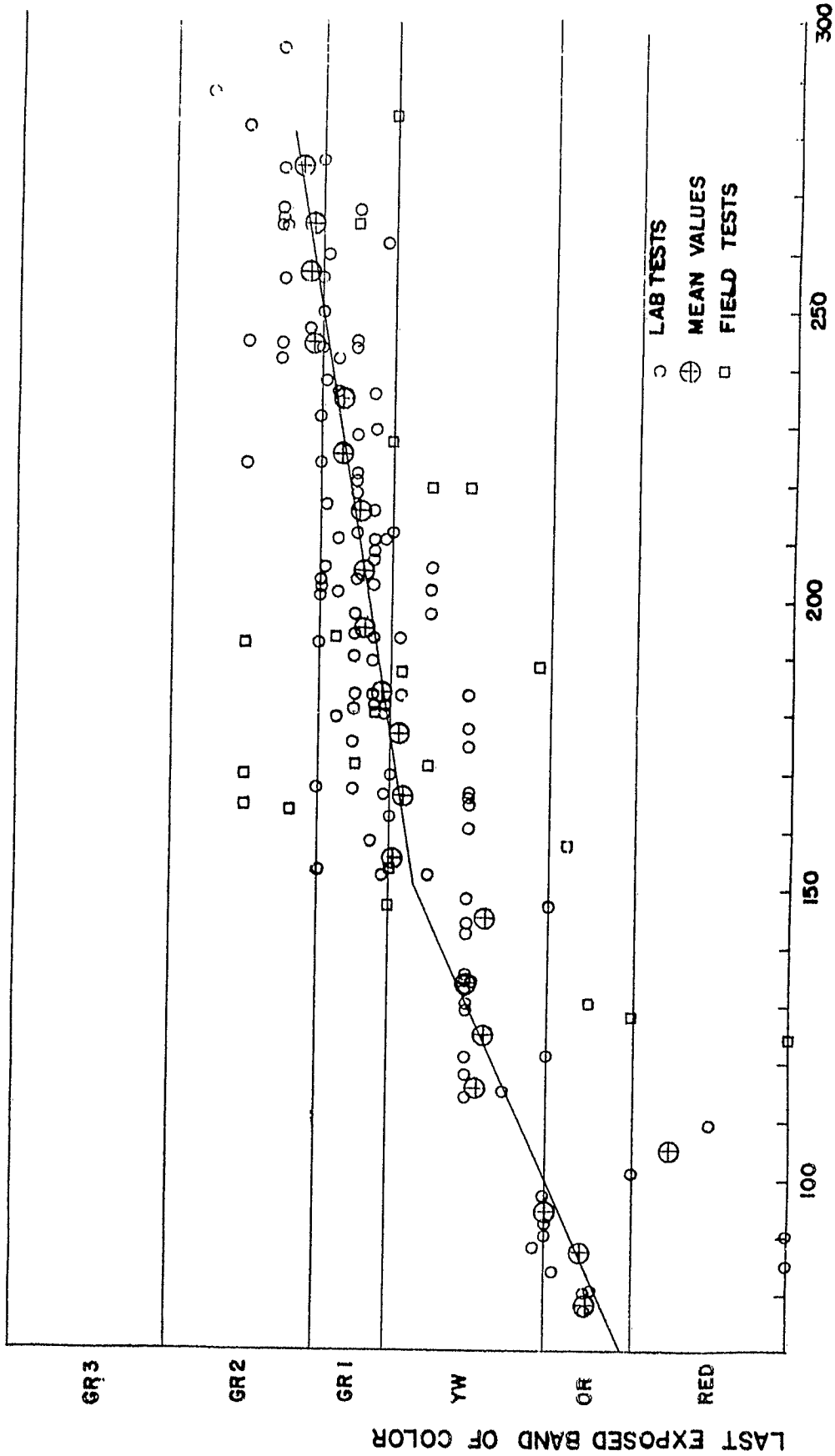


FIG. 21 AVERAGE SEYBOTH TESTER I READINGS VS MULLEN BURST STRENGTH FOR THE SAME DOPED-FABRIC SAMPLES

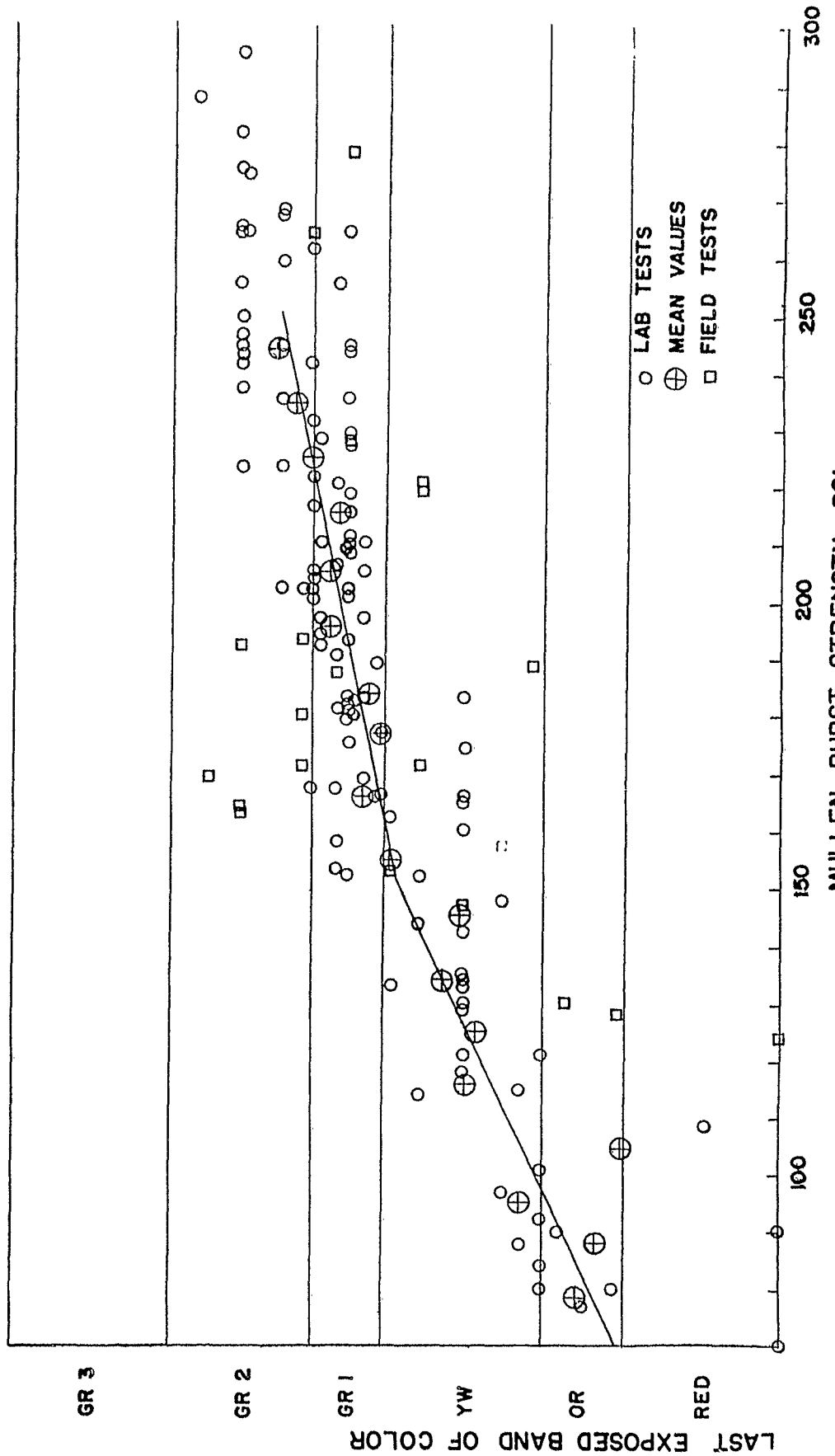


FIG. 22 AVERAGE SEYBOTH TESTER 2 READINGS VS MULLEN BURST STRENGTH FOR THE SAME DOPED-FABRIC SAMPLES

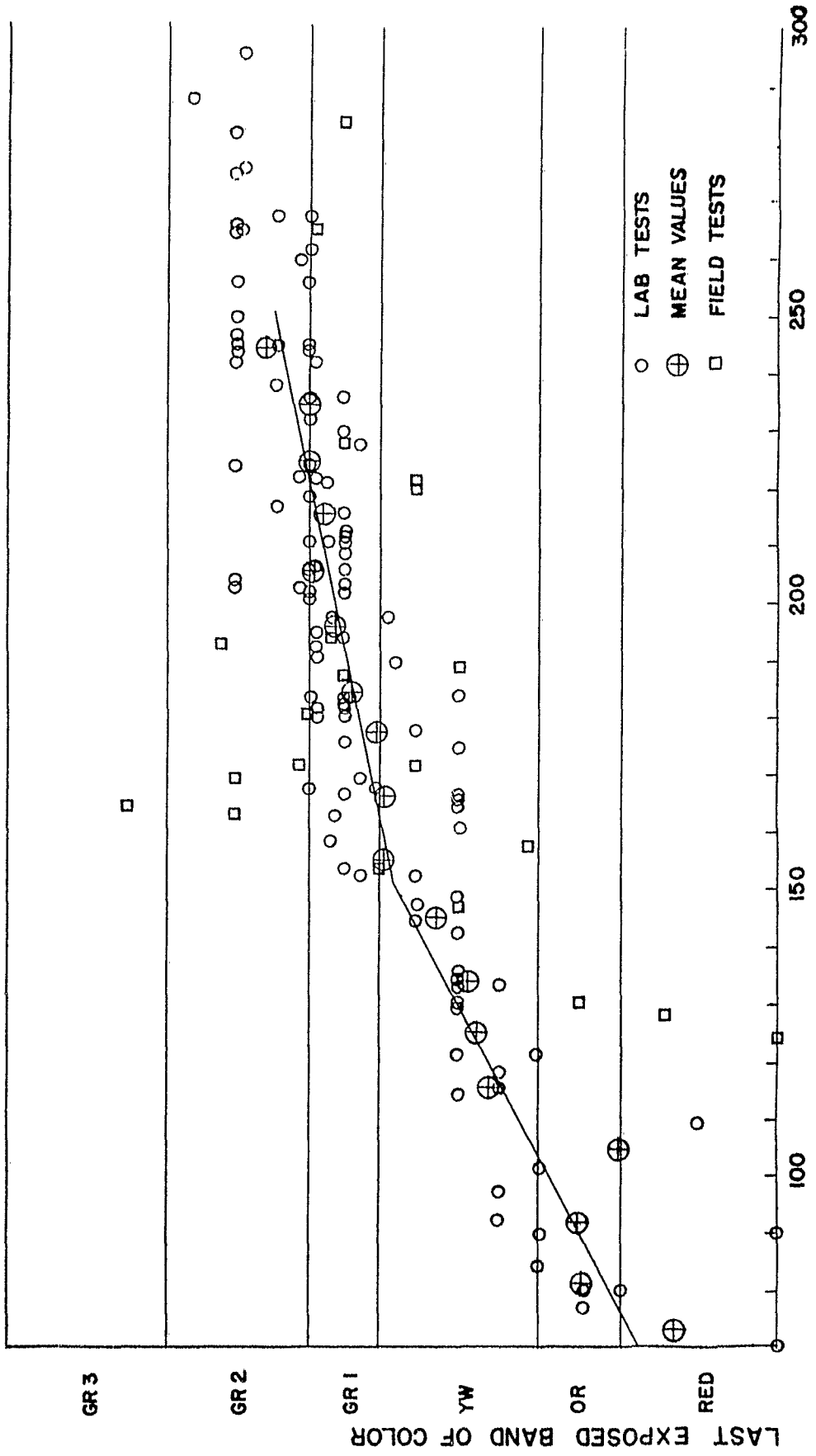


FIG. 23 AVERAGE SEYBOTH TESTER 3 READINGS VS MULLEN BURST STRENGTH FOR THE SAME DOPED-FABRIC SAMPLES

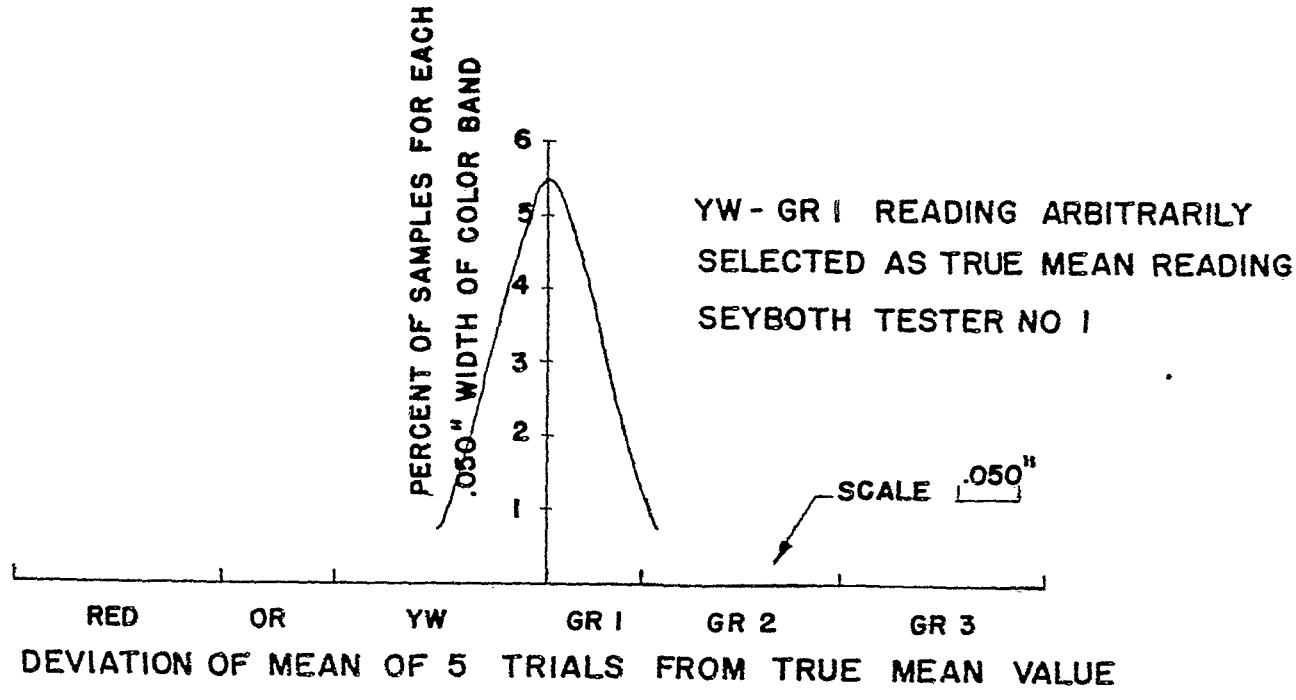


FIG 24 DISTRIBUTION OF SEYBOTH TESTER READINGS ABOUT THE CORRELATION LINE

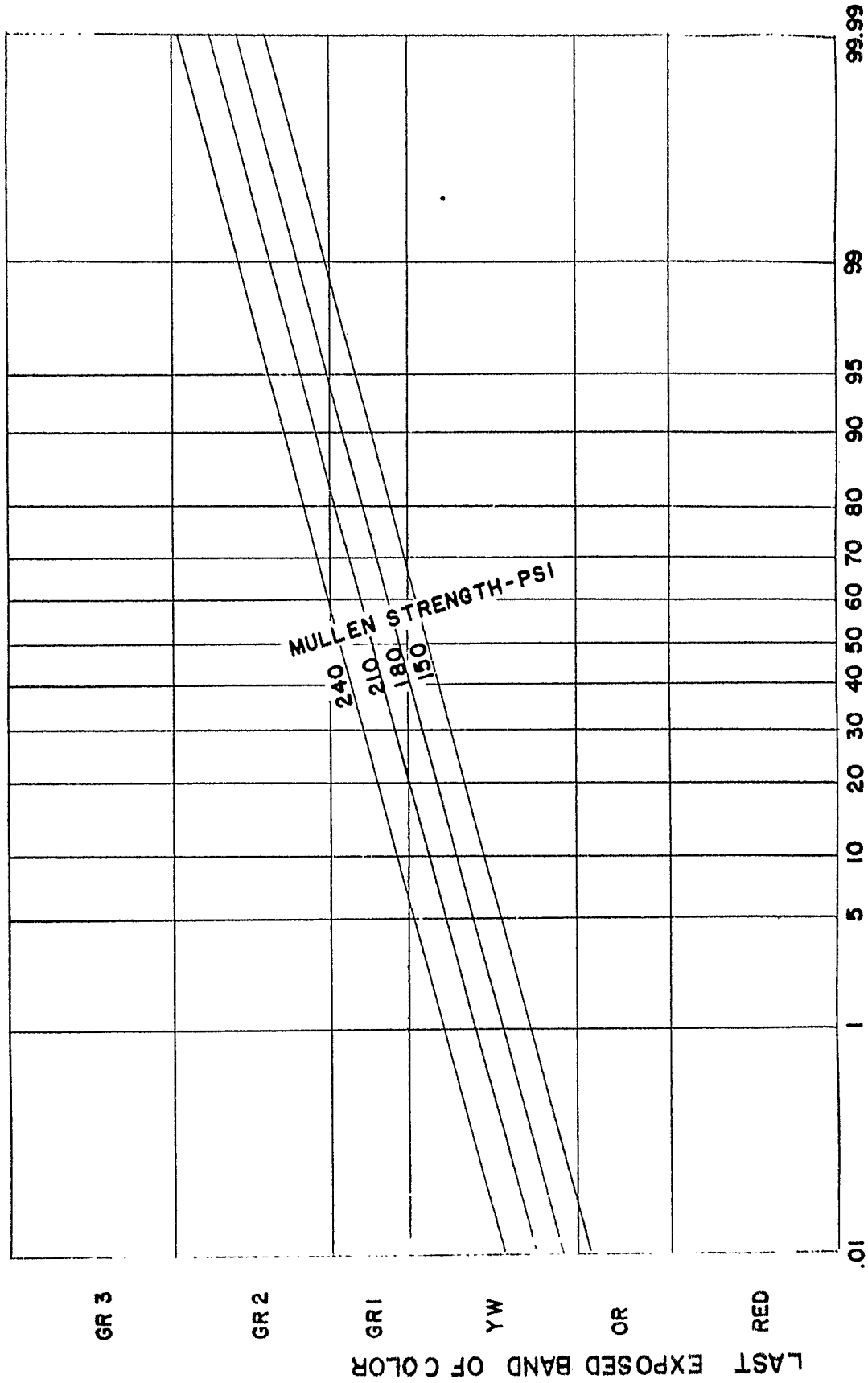


FIG. 25 PROBABILITY OF DIFFERENT SEYBOTH TESTER I READINGS FOR SAMPLES OF DIFFERENT MULLEN STRENGTHS

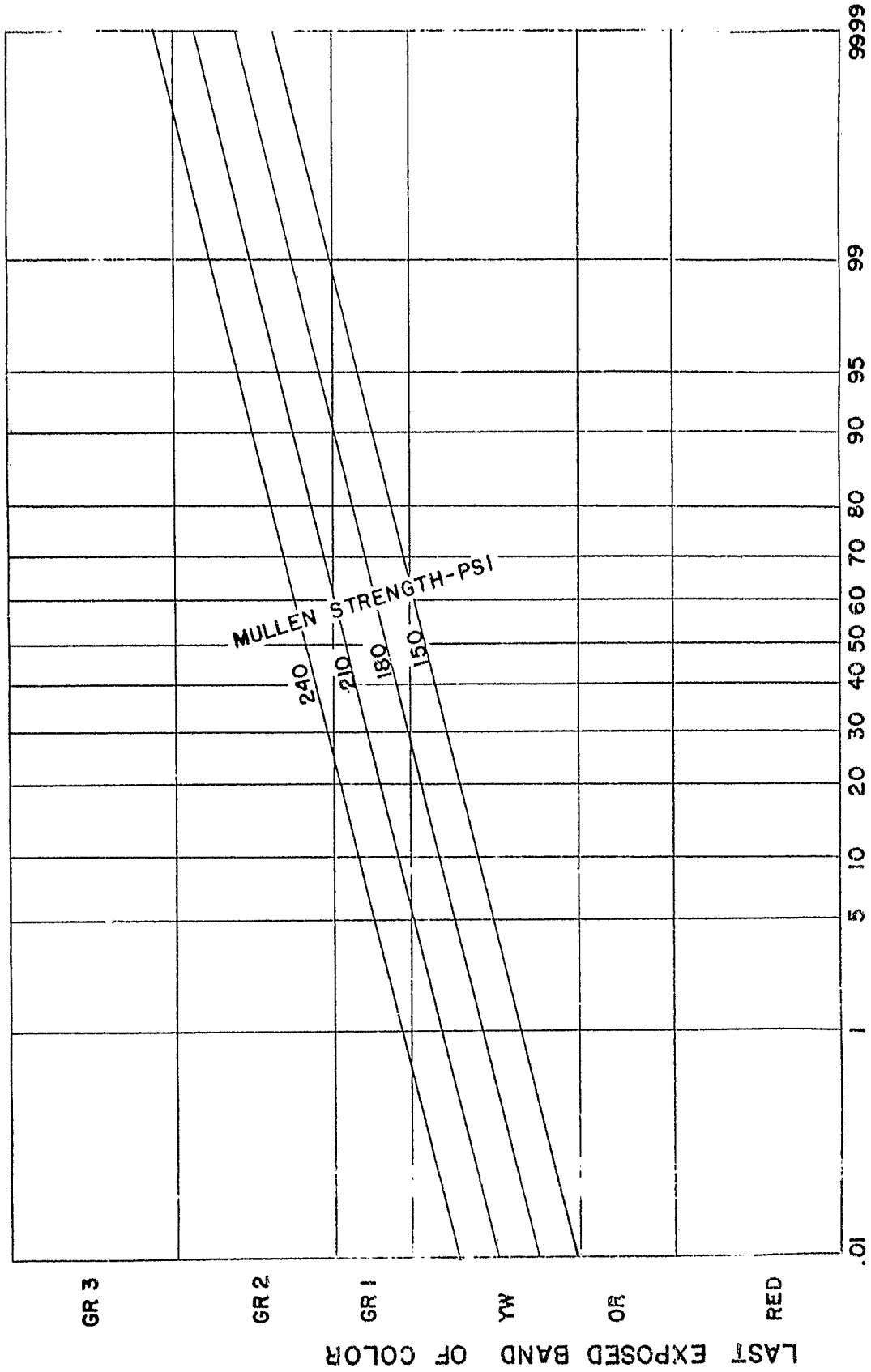


FIG. 26 PROBABILITY OF DIFFERENT SEYBOTH TESTER 2 READINGS FOR SAMPLES OF DIFFERENT MULLEN STRENGTHS

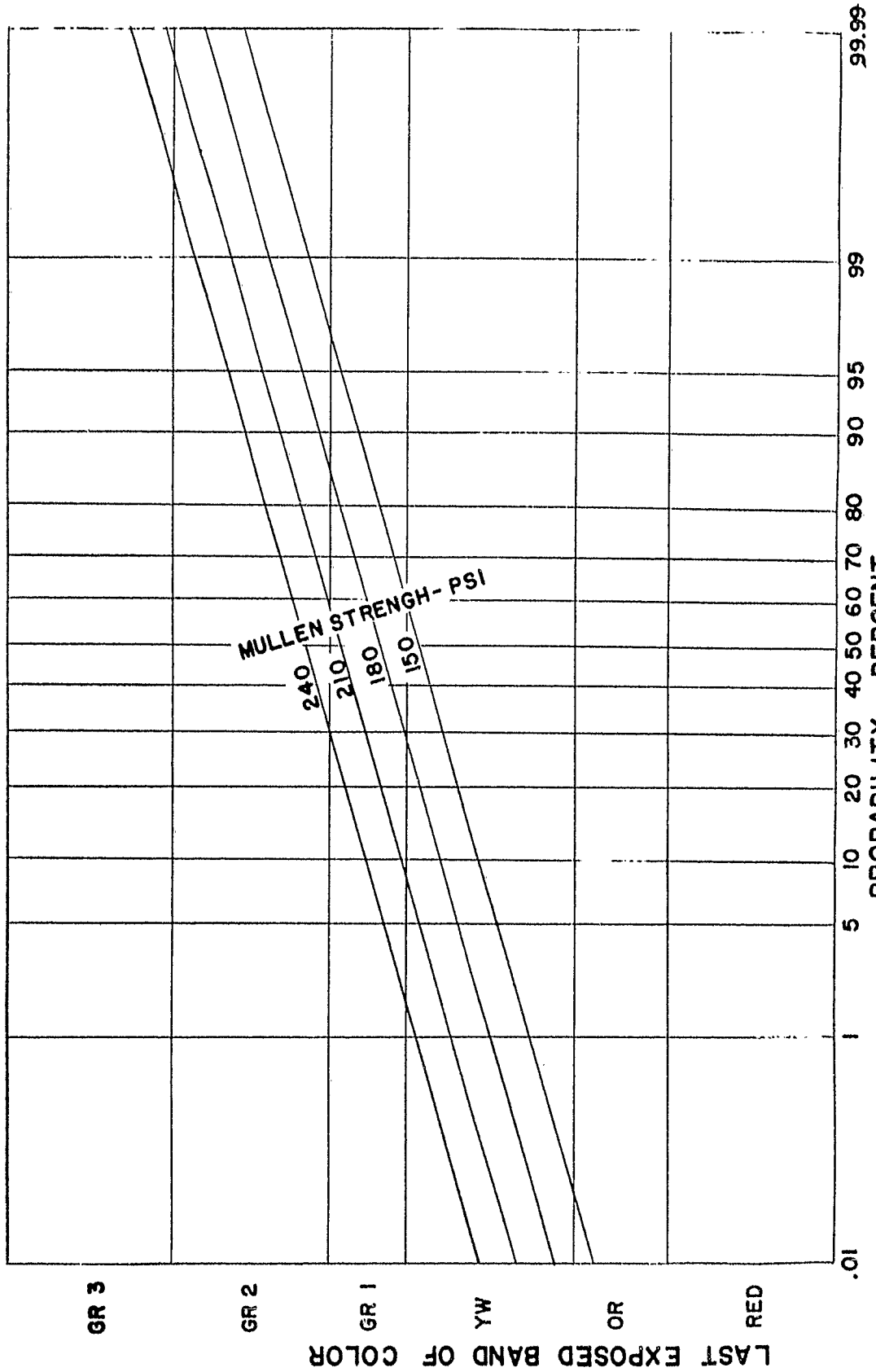


FIG.27 PROBABILITY OF DIFFERENT SEYBOTH TESTER 3 READINGS FOR SAMPLES OF DIFFERENT MULLEN STRENGTHS

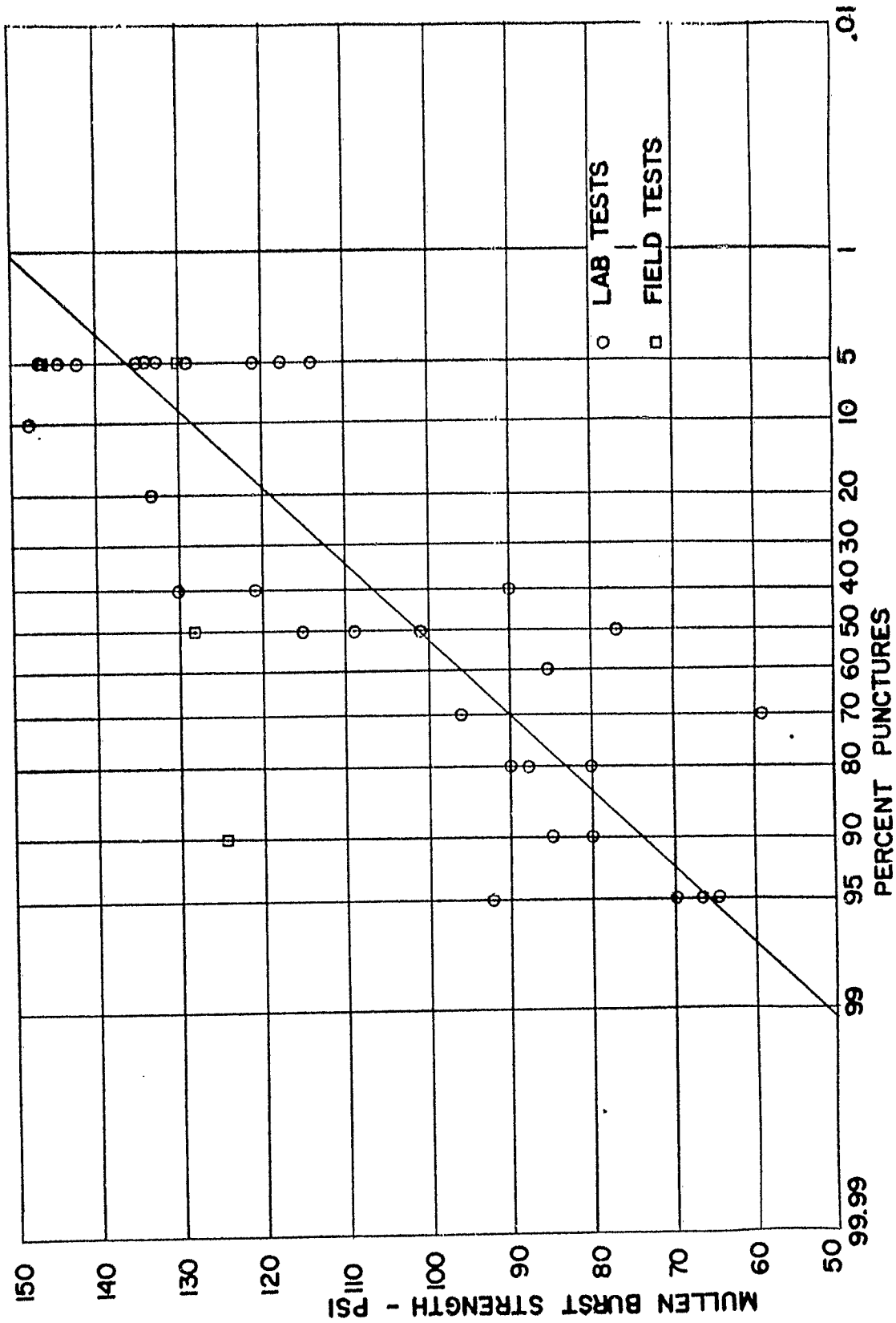


FIG. 28 PERCENT OF PUNCTURES WITH CAA TESTER 1751 VS MULLEN BURST STRENGTH FOR THE SAME DOPED-FABRIC SAMPLES

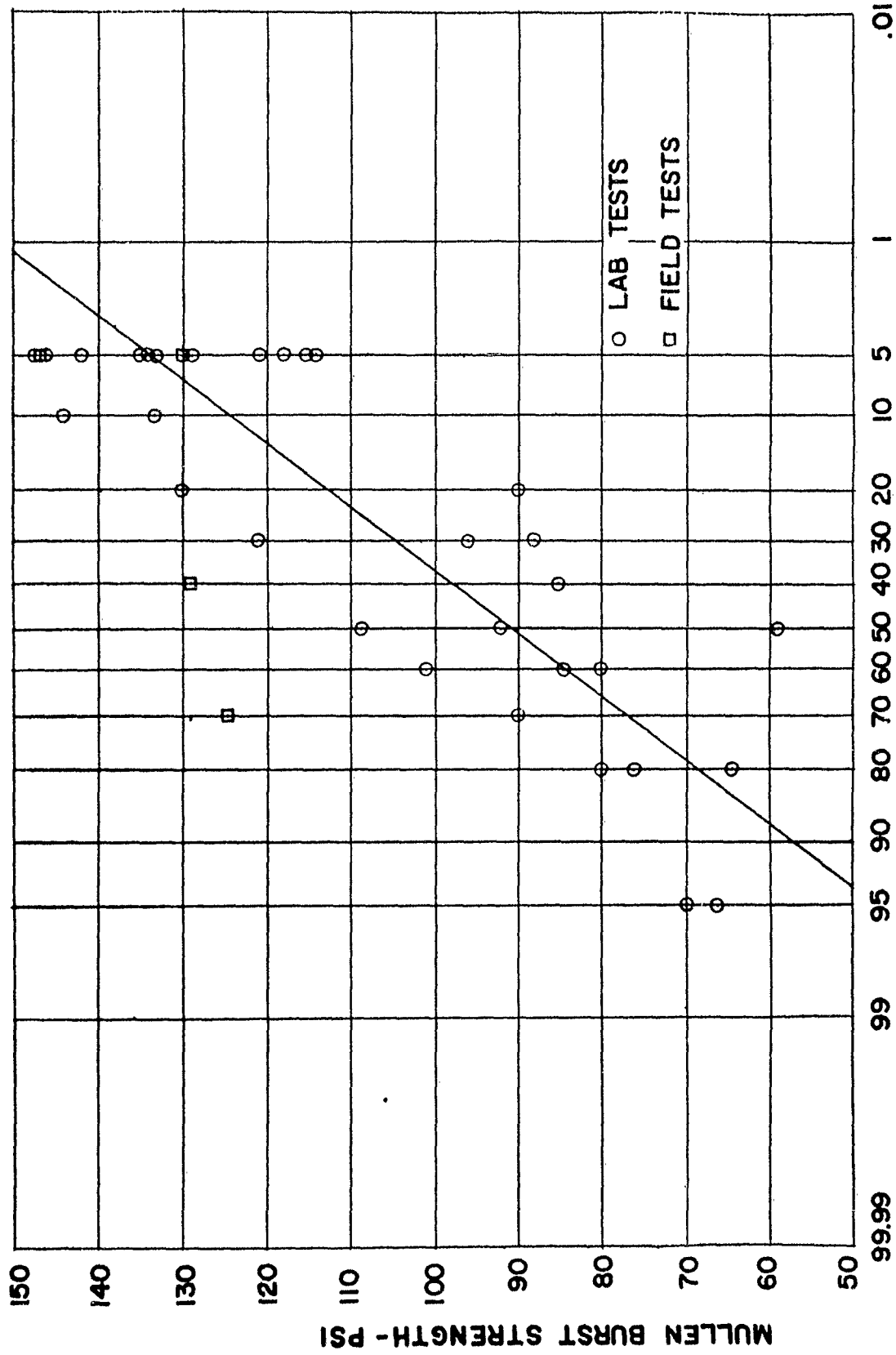


FIG. 29 PERCENT OF PUNCTURES WITH CAA TESTER 2036 VS MULLEN BURST STRENGTH FOR THE SAME DOPED - FABRIC SAMPLES

Figure 30 - Method of Testing Doped-Fabric Surfaces on Aircraft

REFERENCES

Reference	
1	Jukkola, E. E.: Evaluation of the Condition of Doped-Fabric Surfaces by the Mullen Burst Strength Test and Other Methods. Air Force Technical Report No. 5700, including Supplement 2, July 1950.
2	CCC-T-191b: Federal Specification - Textile Test Methods, 15 May 1951, including Amendment 3, November 23, 1953.
3	Dixon, W.J., and Massey, F. J., Jr.: Introduction to Statistical Analysis. McGraw-Hill Book Co., New York, 1951.